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ABSTRACT

This study, which is a partial replication and validation of the 1962 Laurendeau and Pinard study of causal thinking, investigates cross-cultural differences among three age levels of Canadian and American school children in the development of causal thinking. Also studied is the relationship between level of development of causal thinking and variables of age, sex, IQ, and grade placement. Seventy-five boys and 75 girls, ages 6, 8, and 11 years, were administered the Laurendeau and Pinard questionnaires (included in appendixes) to elicit responses about concepts of dream, life, the origin of night, the movement of clouds, and the floating and sinking of objects. Responses were evaluated for instances of precausal thinking, i.e. realism, animism, artificialism, finalism, and dynamism. Analyses of the data support the Piaget (1927) and the Laurendeau and Pinard (1962) findings with regard to the three age-related stages of development of causal thinking, and the manifestation of precausal forms of thinking. Significant differences appear for the dimensions of age and school grade for the American subjects. Significant differences between Canadian and American children are found in level of development attained in all the concepts; exception was the concept of life. (NH)

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Final Report

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A Study of Causal Thinking in Elementary School Children

Edna M. Ward

Emerson College

Boston, Massachusetts

June 1970

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SUMMARY

This study was a partial replication of the Laurendeau and Pinard (1962) investigation of causal thinking in children. Reflecting their basic intent, it was aimed at the verification of the existence of precausal thinking and of the characteristic stages in the development of causal thinking as predicated by Piaget (1927).

It was also intended as: (a) a partial validation study for the Laurendeau and Pinard (1962) findings which were obtained on a sample of French-speaking, Canadian Catholic-school children; (b) a search for cross-cultural differences between three age levels of Canadian and American school children in the development of causal thinking; and (c) an investigation of the relationship between level of development of causal thinking and the variables of age, sex, IQ, and grade placement.

The sample was composed of 75 boys and 75 girls, ages six, eight, and eleven. The subjects were enrolled in grades 1, 3, and 6 of the public elementary schools of Norwell, Massachusetts, a predominantly white, middle-class, suburban town. IQ scores ranged from 84 to 155 with a median IQ 116.

The standardized Laurendeau and Pinard (1962) questionnaires were administered to each subject to elicit responses concerning the concepts of dream, life, the origin of night, the movement of clouds, and the floating and sinking of objects. After the responses were evaluated for instances of precausal thinking, i.e. realism, animism, artificialism, finalism, and dynamism, the subjects were assigned to developmental stages for each concept by three independent judges employing the Laurendeau and Pinard (1962) evaluation scales. Thus, the data were reported in terms of the frequency of usage of the various forms of precausal thinking and the frequency of subjects appearing at each stage of development for each concept.

Chi square analysis was employed to determine if the stages of development for the American subjects were influenced by sex, age, school grade, or IQ. The Friedman two-way analysis of variance by ranks was used to determine whether the stage of development was influenced by the concept being tested. The chi square technique was also applied to the comparison of the developmental stages of the Canadian and American samples, differentiated by sex and age. All statistical tests were made at the .01 level of significance.

The results of this study support the Piaget (1927) and Laurendeau and Pinard (1962) findings with regard to the three age-related stages of development and the manifestation of precausal forms of thinking. These aspects of the development of causal thinking appear to be constant across cultures although the rate of development varies.

The stages of development of the American subjects were not influenced by sex or IQ. However significant differences were found for the dimensions of age and school grade. Although precausal responses were found in all age groups, the use of precausal modes of thinking decreases with increasing age and grade placement.

The various concepts appear to have a differential effect. That is, the level of development attained by the American subjects on the Laurendeau and Pinard questionnaires varied with the concept being tested.

There were significant differences between Canadian and American children in the level of development attained on the concepts of dream, the origin of night, the movement of clouds, and the floating and sinking of objects, but not on the concept of life. The differences appear to favor the older American children which suggests that suburban, American public-school children acquire causal thinking earlier than do urban, French-speaking, Canadian Catholic-school children.

Chapter I

Introduction

American educational and psychological thought has been influenced increasingly over the last two decades by Piaget's theory of intellectual development. Considerable research has been generated by his theory, much of which attempts to replicate or validate Piaget's findings. However, recently there has been an emphasis on the application of findings to diagnostic evaluation, curriculum development, and educational methodology (Sigel and Hooper, 1968). The value of such application is dependent upon the validity of the conclusions of the basic studies.

In 1962 the Canadian psychologists Laurendeau and Pinard published the first report of an extensive project designed to replicate, validate, and apply Piaget's conclusions concerning the stages of mental development. As part of the project, twenty-seven questionnaires, derived from Piaget's work, were administered to a stratified sample of French-speaking, Canadian children most of whom were attending Catholic schools in Montreal. The norms developed from this sample are to be incorporated into a new scale of intellectual development.

Five of the questionnaires were specifically designed to investigate the child's conception of reality and causality which Piaget had treated in *The Child's Conception of the World* (1926),[1] and *The Child's Conception of Physical Causality* (1927). The findings with regard to these five questionnaires were presented in the initial report, *Causal Thinking in the Child* (Laurendeau and Pinard, 1962).

If the results of the questionnaires used in the project are similar for American, public-school children, the norms provided by this new mental development scale could be used with confidence as a diagnostic aid and as the basis of curricula revision.

Purpose of the Study

This study was a partial replication of the Laurendeau and Pinard (1962) investigation of causal thinking. Reflecting their basic intent, it was aimed at the verification of the existence of precausal thinking and of the characteristic stages in the development of causal thinking as predicated by Piaget (1926, 1927).

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[1] Wherever the work of Piaget is cited in this study, the year refers to the date of the original French publication in order to maintain the chronology. In the case of quotations, the page number refers to the American edition listed in the bibliography.

However, it was also intended as: (a) a partial validation study for the Laurendeau and Pinard (1962) findings; (b) a search for cross-cultural differences between three age levels of Canadian and American school children in the development of causal thinking; and (c) an investigation of the relationship between level of development and the variables of age, sex, IQ, and grade placement.

In general, this study proposed to test the null hypothesis of no difference in the amount and kind of precausal thinking found in the responses of French-speaking, Canadian, Catholic-school children and English-speaking, American, public-school children as elicited by the Laurendeau and Pinard experimental questionnaires.

More specifically, this study was designed to answer the following questions:

1. Is there any evidence of precausal thinking in the responses of this sample? If so, what kind, and how predominant is it? How does this compare with the Laurendeau and Pinard sample?

2. Is there any evidence to support Ezer's (1961) conclusion that children who have had more formal religious instruction offer more animistic explanations than children who have had a lesser amount of formal religious instruction?

3. Are there any differences in the amount and kind of precausal responses of boys and girls? Are there any differences in the developmental levels of boys and girls? How does this compare with Laurendeau and Pinard's findings?

4. Is there any relationship between age and level of development of causal thinking? How does this compare with Laurendeau and Pinard's finding?

5. Is there any relationship between grade placement and the level of development of causal thinking?

6. Is there any relationship between IQ and the level of development of causal thinking?

7. Are there any differences in the developmental levels of French-speaking, Canadian, Catholic-school children and English-speaking, American, public-school children?

8. Does the level of development attained remain constant or does it vary with the concept being tested?

Limitations

This study was limited to the investigation of causal thinking in a sample of 150 American, public-school children ages six, eight, and eleven, equally divided by sex and grade placement. At the time of interviewing the subjects were enrolled in grades one, three, and six of the Norwell, Massachusetts elementary schools.

All of the subjects were of normal intelligence and free from any known serious, physical defects. They were all from middle-class homes and, with the exception of one subject, were Caucasian.

It was assumed that if the underlying theory was correct, there would be a regular, ascending gradation of responses in the direction of causal thinking. These age-grade levels were considered to be pivotal points in academic experience and transitional points in the development of causal thinking.

The interviewing took place in a six-week period extending from September 10, 1969 to October 22, 1969. All interviewing was conducted by the writer in the schools during regularly scheduled school hours. Each child was seen once for an average of forty-five minutes.

As with the Laurendeau and Pinard (1962) study, "only the symbolic forms of causality are considered (p. 2)." The data were obtained through the administration of the Laurendeau and Pinard experimental questionnaires designed to elicit responses concerning the following phenomena: (a) dreams; (b) life; (c) the origin of night; (d) the movement of clouds; and (e) the floating and sinking of objects. (See Appendix A). The protocols were subsequently evaluated according to the scales which had been provided (Laurendeau and Pinard, 1962, pp. 103-230).

Since the sample was limited to three age levels, it was not possible to validate the age of accession to stages of development.

Definition of Terms

A definition of causal thinking, per se, is not provided by either Piaget or Laurendeau and Pinard. Under the heading "Causal thinking" in their Subject Index, the latter authors suggest "see Precausal thinking, Physicalism" (Laurendeau and Pinard, 1962, p. 291).

Piaget does, however, define causality in The Construction of Reality in the Child (1936).

> Causality consists in an organization of the universe caused by the totality of relations established by action and then by representation between objects as well as between object and subject (p. 315).

For purpose of this study, causal thinking was understood to mean that form of thinking which is characterized by (a) an awareness of the temporal and spatial relations of cause and effect, and (b) the ability to identify objectively the producer of the effect.

Precausality is defined by Piaget (1927) as "the confusion of relations of a psychological or biological type in general with relations of a mechanical type . . . (p. 267)." Laurendeau and Pinard (1962) state that "this term will include all forms of explanation antecedent to the ones depending on physical and objective connections (p. 10)."

The major forms of precausality which were elicited in this study are defined below:

Realism - consists in ignoring the existence of self and thence regarding one's own perspective as immediately objective and absolute (Piaget, 1926, p. 34).

Finalism - in this perspective, reality is conceived as a world organized along well-determined plans and almost always centered upon human activity (Laurendeau and Pinard, 1962, p. 12).

Artificialism - draws its principle from finalism which it complements by positing the explicit action of a maker at the origin of things: either God or men are held responsible for the existence of all objects, natural or artificial, observed in the external world (Laurendeau and Pinard, 1962, p. 12).

Animism and Dynamism - through animism, the child gives life and consciousness to surrounding objects, and through dynamism, he grants them an energy similar to man's muscular strength which makes them capable of all sorts of efforts and motions (Laurendeau and Pinard, 1962, p. 13).

Some Background Considerations

The development of causal thinking is an integral part of the development of logical thinking. As egocentricity must give way to objectivity in the child's construction of reality, transductive thinking must give way to deductive thinking in the child's symbolic representation of that reality.

Piaget, (1926, 1927, 1936), has given us a conceptual framework within which to study the changes that occur as the child makes these transitions. He postulated the existence of specific forms of pre-causal (pre-logical) thinking which naturally evolve from the child's interaction with his environment. He also postulated an invariant sequence of stages which characterize the evolution of causal (logical) thinking.

The research results (See Chapter II) which followed the appearance of this theory were often contradictory and inconclusive. Thus, the first task which Laurendeau and Pinard (1962) undertook in their study of causal thinking was the identification of sources of inconsistency in previous studies.

In the Preface to *Causal Thinking in the Child*, (Laurendeau and Pinard, 1962), Piaget claimed that "the remarkable result of this critique of critics is that M. Laurendeau and A. Pinard have solved the methodological problem with which they were faced (p. xv)." If this claim is valid, then, replication of the Laurendeau and Pinard (1962) study should yield approximately the same results. This claim provided the impetus for the present study.

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Statement of Hypotheses

In order to answer the questions which had been raised, the following hypotheses were formulated:[1]

1. H_o: There is no evidence of realism, animism, artificialism, finalism, and dynamism in the responses of this sample to the Laurendeau and Pinard questionnaires.

2. H_o: There is no difference in the frequency of animistic explanations offered by children who attend all-day Catholic-schools and children who attend public schools as measured by the Laurendeau and Pinard questionnaire on the concept of life.

3. H_o: There is no difference between boys and girls in the frequency of usage of realism, animism, artificialism, finalism, and dynamism.

4. H_o: There is no difference between boys and girls in the level of development attained for each of the following concepts:

    (a) Dream
    (b) Life
    (c) The origin of night
    (d) The movement of clouds
    (e) The floating and sinking of objects

5. H_o: There is no difference between Canadian and American girls in the level of development attained for each of the following concepts:

    (a) Dream
    (b) Life
    (c) The origin of night
    (d) The movement of clouds
    (e) The floating and sinking of objects

6. H_o: There is no difference between Canadian and American boys in the level of development attained for each of the following concepts:

    (a) Dream
    (b) Life
    (c) The origin of night
    (d) The movement of clouds
    (e) The floating and sinking of objects

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[1] For ease of presentation the Laurendeau and Pinard (1962) sample is hereafter designated "Canadian" and the sample of this study is designated "American."

7. H_o: There is no difference in the level of development attained by eleven, eight, and six-year-old children on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

8. H_o: There is no difference between eleven-year-old Canadian and American children in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

9. H_o: There is no difference between eight-year-old Canadian and American children in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

10. H_o: There is no difference between six-year-old Canadian and American children in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

11. H_o: There is no difference in the level of development attained by children in school grades one, three, and six on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

12. H_o: There is no difference between children of varying IQ scores in the level of development attained on each of the following concepts:

   (a) Dream
   (b) Life
   (c) The origin of night
   (d) The movement of clouds
   (e) The floating and sinking of objects

13. H_o: There is no difference between Canadian and American children in the level of development attained on each of the following concepts:

   (a) Dream
   (b) Life
   (c) The origin of night
   (d) The movement of clouds
   (e) The floating and sinking of objects

14. H_o: The level of development attained on the Laurendeau and Pinard questionnaires does not vary with the concept being tested.

The next chapter reviews the most pertinent research related to these hypotheses and to the concept of causal thinking.

Chapter II

Review of Related Research

A major portion of the research on causal thinking evolved from the theoretical postulations and empirical evidence presented in The Child's Conception of the World (Piaget, 1926), and The Child's Conception of Physical Causality (Piaget, 1927). Since these studies hold an important place in the research literature a brief review of their major findings is presented first.

Piaget

In his first two books, The Language and Thought of the Child (1923), and Judgment and Reasoning in the Child (1924), Piaget analyzed the form and function of the child's thinking, expressed through language usage, and found it to be extremely egocentric. In The Child's Conception of the World (1926), and The Child's Conception of Physical Causality (1927) Piaget presented an analysis of the content of the child's thinking to illustrate specifically how the form and function are manifested in the child's developing notions of reality and causality.

Piaget was convinced that the child's thought was qualitatively different from that of the adult because of its essentially egocentric character. Flavell (1963) stated, "Most of the developmental changes these books describe either are or could be interpreted in terms of a gradual replacement of egocentric thought by socialized thought in the growing child (p. 270)."

Initially, then, according to Piagetian thinking, the world and the relation of things and events in that world are explained in terms of the self. A more objective view develops as the child begins to differentiate between the internal and external worlds. Since this task of differentiation is a gradual, interactive process the child often confuses the physical properties of the world with the psychological properties of the self. As Piaget (1927) found, "at every stage there remains in the conception of nature what we might call 'adherences,' fragments of internal experience which still cling to the external world (p. 244)."

These 'adherences' are manifested in the form of phenomenistic, animistic, artificialistic, finalistic, or dynamistic responses to questions concerning the causes of physical phenomena. It is these primitive, precausal thought forms that the child must relinquish as he develops a logical, objective view of reality.

According to Piaget (1927), there are three age-related stages in the development of the logic of the concept of causality. The first stage, lasting till age 2-3, is logically equivalent to the autism of early childhood in which the child sees himself as "the first cause" of all things.

The second stage, logically characterized by egocentrism and syncretism, marks the transition from the autism of early childhood to the logic of adulthood. In the third stage, which is reached at about 7-8 and completed by age 11-12, the child's thinking is characterized by the objectivity of the logical adult model.

In his description of the development of the concept of causality Piaget (1927) distinguished seventeen types of causal relation in child thought which are subsumed under the three stages.

> Having distinguished these seventeen types, we can now lay down three main periods in the development of child causality. During the first, all the explanations given are psychological, phenomenistic, finalistic, and magical (types I-VI). During the second stage, the explanations are artificialist, animistic and dynamic (types VII-IX), and the magical forms (III and IV) tend to diminish. Finally during a third period, the preceding forms of explanation dissappear progressively and give place to the more rational forms (X to XVII). Thus the first two periods are characterised by what we have called pre-causality (in the widest sense of the word), i.e. by the confusion of relations of a psychological or biological type in general with relations of a mechanical type, and true causality does not appear till about the age of 7-8 (third period) (pp. 258-267).

It was this delineation of the stages and their characteristic thought forms that gave rise to much of the research which was to follow. However, the method of collection, interpretation, and reportage of the data upon which the theoretical formulations were based was to receive a large measure of criticism.

The primary, testable hypotheses which seemed to emerge from these studies (Piaget, 1926, 1927) may be listed as follows: (a) the concept of causality is developed in an invariant sequence of age-related stages; (b) the stages of development are characterized by specific types of causal thinking which reflect an underlying continuum from egocentricity to objectivity; and (c) the first two stages are saturated with pre-causal forms of thinking.

The research studies following the publication of The Child's Conception of the World (Piaget, 1926), and The Child's Conception of Physical Causality (Piaget, 1927) produced conflicting and often controversial results. The following chronological review covers the period 1930 to the present. The Laurendeau and Pinard (1962) study receives separate treatment because it attempts to explain the divergence in the results of the preceding studies and also because it is the basis of the present study.

1930-1939

Three studies were reported in 1930, all of which disagree with Piaget. Hazlett (1930), working with both children and adults, failed to find any radical differences in their thought processes. She felt that the child's lack of experience accounted for his inability to see relations, and, that faced with unfamiliar material, the adult makes the same kind of logical errors as the child. She concluded that "Piaget's picture of a striking difference between adult and childish thinking is, I believe, due to an over-valuation of verbal expression as a measure of thinking, and an exaggerated view of the logicality of adult thought (p. 361)."

Huang (1930) limited his experiments to phenomena outside the daily experience of the child. He individually interviewed 47 subjects between 4 and 10 years of age and 11 college girls presenting for explanation such things as conjurer's tricks and illusions. He found that nearly all the explanations were naturalistic, physical concepts with few instances of precausality. This difference from Piaget's findings he attributed in part to the environment of the child and in part to the type of questions asked. He further concluded that some explanations are based on previous knowledge or preceptual suggestion. He found the explanations of the young children comparable to those of the college students.

Isaacs' (1930) study utilized data obtained from the records and observations of a small group of children ages 2.7 to 10.5 who were attending the Malting House School in Cambridge, England. She concluded that an appreciation of mechanical causality appeared spontaneously much earlier than Piaget had suggested. She argued against Piaget's maturational viewpoint and emphasized the relation of interest and experience to the appearance of explanations of mechanical phenomena. She further argued against the clinical method as suggesting the answers for some children and as putting others at an intellectual disadvantage. The clinical method, she felt, was too artificial and that the only way to measure the child's real level of understanding was to observe him in natural situations.

Although Johnson and Josey (1931) replicated Piaget's experiments, they failed to substantiate his findings. They found no precausal thinking even in six year old children. Nor did they see any evidence of egocentrism. They offered as possible explanations of the differences: (a) that their subjects were slightly superior in intelligence and economic status, and (b) that perhaps English is superior to French as an instrument for logical thinking.

Using the clinical method with 83 S's (2.8 to 6.4 years), Grigsby (1932) studied the development of the concepts of time, space, part-whole, cause, discordance, and number. She classified the causal responses according to Piaget's 17 types of causality and found results in agreement with his. While most experimenters find the Piaget classification too numerous, Grigsby added five more to the list. However, she objected to Piaget's age criterion since she had found adequate expression of causal relation in children as young as 2½ years.

Explanations of natural phenomena were elicited by Zawirska (1932), employing a group test with 218 S's and individual tests with 24 S's. The children, ages 9 to 11, were from the secondary and communal schools of Warsaw and the surrounding country. He found evidence of animistic and dynamistic responses as well as more scientific explanations. The more modern scientific conceptions appeared to a greater degree in the responses of urban children.

Keen (1934) found no evidence of consistent stages of development. This is not surprising since her Russian subjects were in grades 6, 7, 10, 11, and in the university. Her data were derived by use of a group testing technique employing multiple-choice answers to questions and by individual testing. She found that responses were affected by the S's ability to use language and to organize and systematize previous knowledge and experience. However, she found no differences between S's of differing ages as to the method used in formulating experiences. Piaget's stages were represented but in different proportions. She concluded that the gradual development of the reasoning process was due to a more effective organization of concepts and to the growth of self-criticism.

Duetsche (1937) also used a group testing technique with 732 children ages 8 to 16, in grades 3 to 8. Two forms of a questionnaire requiring written answers were devised. Form 1 included 11 questions preceded by demonstrations of simple, physical experiments. Form II included 12 questions dealing with more general natural phenomena, without demonstrations. For comparison 13 kindergarten children were individually questioned about the same phenomena. The responses were rated on an eight point scale according to their scientific accuracy. Analysis of the quantified scores revealed: (a) consistent increase with age; (b) boys received higher scores than girls particularly on Form 1 where the influence of direct training was probably less; (c) slight relationship between scores and socio-economic status; (d) low correlation with intelligence; and (e) a fairly high relationship between scores and grade placement. She also found that the qualitative answers of the kindergarten group were largely of the mechanical and logical deduction type.

In reference to Piaget's findings, Deutsche felt that his classification into 17 types of causal thinking was no longer useful. She could find no evidence that children's reasoning developed by stages since all kinds of answers were found spread widely over the age range. She suggested that specific answers are more dependent on direct or indirect instruction or training than on innate intelligence.

Using the clinical method with a series of simple demonstrations of buoyancy, Sarvis (1939) studied the development of physical causality in conjunction with the development of moral judgment. He was able to classify the responses of 274 S's ages 2 to 17 into Piaget's 17 types of causal relation. His findings were in general agreement with Piaget. He found no parallel course of development for the concept of physical causality and for moral judgment.

Lacey and Dallenbach (1939) found that S's learn the cause-effect relation without special instruction by the end of the eighth or beginning of the ninth year which agrees with Piaget's findings. However, they also found evidence that with special instruction children in the age group 6.7 to 7.0 have a probability of .5 of learning the relation.

1940-1949

Russell and Dennis (1939) developed a standardized questionnaire, based on Piaget's clinical method, for the investigation of animism in child thought. This testing instrument was then used in a series of studies with a wide range of subjects.

Russel (1940a, 1940b) concluded: (a) that Piaget's classification of the stages of animism were valid; (b) children probably pass sequentially through the stages with increasing mental and chronological age; (c) it is impossible to limit the age range of the stages; (d) the development of animism is not related to geographical location, socio-economic status or sex but is equally related to both MA and CA.

Russell, Dennis, and Ash (1940) used the standardized questionnaire with feeble minded subjects and concluded that "age is a variable which affects the development of ideas when MA is held constant by an appropriate selection of cases (p. 62)."

Dennis (1942) also reported a longitudinal study of his own daughter over a three year period. The child was asked questions taken from various sections of The Child's Conception of the World (Piaget, 1920). Her development was entirely in agreement with the sequence described by Piaget but occurred at a much earlier age. Dennis rejected the hypothesis that the child's answers are transmitted by adults. He felt that her answers were developed from her own experiences.

After an extensive survey of the literature Huang (1943) found it impossible to accept Piaget's characterization of the young child's thought as precausal. "Instead, simple and naive physical concepts, comparable to those of the every day man in the street, seem to be definitely established and predominant even for the youngest of the children studied (p. 117)." He then attempted to show that what Piaget termed animistic and anthropomorphic explanations were really comprehensible and logical answers.

Huang, Yang and Yao (1945) attempted to explain the factors which might induce a child to use phenomenistic explanations. They concluded that "children can be induced to regard a concomitant fact as the cause of a phenomena, but all concomitant facts are not so accepted with equal readiness. Certain factors of selection are operative and similarity between cause and effect is one of them (p. 68)."

The universal animistic tendency in children was rejected by Huang and Lee (1945). They questioned their 40 Chinese S's ages 3 years 5 months to 8 years 7 months about the life, feeling and function of common objects. They felt the animism when it is used can be explained "by the apparent characteristics of the specific object rather than by any general tendency (p. 73)."

Oakes (1947) employed a conversation interview technique to collect responses to questions regarding various natural phenomena. He tested 77 kindergarteners, 24 second graders, 24 fourth graders, and 28 sixth graders as well as a small group of nonscientific adults. The responses were tabulated according to type of explanation given. He, too, found Piaget's 17 classifications unusable with his data. He found all types of answers given by all age groups and was unable to corroborate Piaget's age-stage theory. The majority of answers were naturalistic. He held that the types of responses given were influenced by the nature of the problem, the wording of the question, the child's experience and vocabulary and probably his IQ.

1950-1959

In 1951, Strauss re-examined the Huang-Lee (1945) data. By analyzing the conclusions he contended that the study was open to an interpretation that would also support Piaget's position.

Klingensmith (1953) felt that the child's usage of the term "alive" was not a good measure of animism. "The present data indicate that when a child states than an inanimate object is alive, particularly an object which evinces activity, he means much less by this term than most adults do, and much less than Piaget seems to have implied that the child means (p. 61)."

Both Dennis (1953) and Crannell (1954) studied animism in college students. Dennis found that about 40 per cent of the students he tested reported as "alive" one or more objects in a group of eight inanimate objects. Crannell discovered that approximately one-third of his students reported that one or more of the same objects were alive.

The effect of personality, experience, and wording of questions on the child's responses to questions regarding physical causality was studied by Nass (1956). Sixty emotionally disturbed children ages 8 to 10 in grades three and four of the New York Public Schools were matched with sixty normally adjusted subjects. All the subjects were of average intelligence. Each major group was divided into two groups and given form A or B of the test. Form A posed questions starting "Why" while form B gave questions starting with "How."

Nass found that the causal thinking of emotionally disturbed children was significantly less mature than that of normal children. He also found that questions about phenomena whose causes were not accessible to direct experience yielded significantly more precausal responses and that questions starting with "Why" also yielded significantly more nonnaturalistic responses.

Interrogating 97 (7 to 10 year old) Swedish children with Huang's method, Klingberg (1957) observed that the distinction between living and not-living is much better developed at this age than Piaget thought. However, even 9 and 10 year old children have difficulty with some objects.

Simmons and Goss (1957) contended that animistic responses were a function of sentence context and instruction. Analyzing the responses of 225 undergraduates they were able to show that instructions to respond like a poet produced a significant increase in animistic responses.

After surveying the cross-cultural research on animism, Jahoda (1959a) suggested the results were not as inconsistent as they at first appear. Most of them produced results conforming to the minimum requirements of Piaget's predictions, i.e., (a) some of the responses of younger children should reveal animism and (b) the proportion of animistic responses should decrease with age. He then listed as some of the probable causes of the differing results: (1) sample size, (2) language, (3) type of problem presented, (4) method of administration, and (5) the personal influence of the investigator.

In the same year Jahoda (1958b) tested 120 African school children with ages approximately 6 to 18. The subjects, living in Accra, were interviewed in the vernacular. The children were asked questions about a story whose main character was an inanimate object and were required to explain how a gramophone works. Although the data revealed less animism than is found in other semi-literate societies, there was a marked decline with age which is in keeping with Piaget's theory.

1960-1969

Evidence of primitive thinking processes in college students was found by Milton (1960). He could find no relationship between intelligence or educational level and the degree to which a student used these primitive thought patterns. His results were consistent with Dennis (1953) and Crannell (1954).

Mogar's (1960) findings lend support to Piaget's theory of the relationship of age to level of causal thinking. She added that the verbal skills, experience and social presence of the older children may also be contributory factors.

Her sixty subjects ranged from 5 years, 4 months through 12 years and were enrolled in the kindergarten, second and fourth grades of the Iowa City, Iowa public schools. Half of the subjects were assigned to an experimental and half to a control group. In one phase of the study the experimental group was given additional learning experiences with the phenomenon in question, the cause of the floating and sinking of objects. Mogar found that the experiment "offers positive evidence that children at these various ages (including those younger than seven) can induce laws from repeated observations of a phenomenon and can explain the event in terms of these laws (p. 64)."

According to Ezer (1961), Piaget did not sufficiently emphasize the role of religion in the development of concepts of physical causality. He tested a sample of Protestant, Jewish, and Catholic boys approximately half of whom attended all-day religious schools while the remainder attended public school. The 153 boys ages six to eight were individually interviewed and given four tests, two open-ended and two multiple-choice.

Religious questionnaires were also sent to the S's parents. The responses of the children were then analyzed according to their school attendance and to the religious devoutness in the home. Ezer concluded that children who attended all-day religious schools and children who came from very devout homes tended to give more animistic and/or anthropomorphic responses to problems involving physical causality.

The aim of Weinberg's (1963) study was to test the generality of egocentric thinking in children as conceptualized by Piaget. The 64 male and 36 female S's performed two categorizing tasks and took the Rorschach test. Piaget's theory received qualified support.

As part of a larger study of children's thinking Almy (1966) included a study of the prediction and explanation of the floating and sinking of objects. Two hundred and forty-five children in grades K-1-2 were tested using a structured interview schedule. Sixty-five of the S's were studied for three years as part of a longitudinal project. The results of the floatation study support Piaget's findings. "Of most importance, there are indications of the different ways that children in the same grade view phenomena and problems that the adult regards as similar or even identical (p. 121)."

Whiteman (1967) administered the Laurendeau and Pinard animism scale to 70 Negro and Puerto Rican children as part of a study of psychological causality. His findings supported Piaget's view that physical causality develops with age. The kindergarten children gave significantly more animistic responses than the older ones. Twice as many kindergarten children as third graders fell into the high animism group.

Laurendeau and Pinard (1962)

In an attempt to analyze the divergent results of the studies of causal thinking, Laurendeau and Pinard (1962) deduced three conditions affecting causal thinking: (a) the method of examination itself; (b) the subjects examined; and (c) the techniques of analysis employed. They concluded that:

> The examination of the various factors capable of explaining these conflicting data leads to hypotheses which cast some doubt mostly on the negative conclusions. When no instance of precausal thinking is observed among children, the reason is frequently that the subjects examined are too old; or else that the concept of precausality does not have the same connotation for different investigators; or, finally, that the techniques of analysis cunningly do away with indications of primitive thinking (Laurendeau and Pinard, 1962, p. 35).

So, with these problems in mind they designed a study which would replicate Piaget's main experiments but under more rigorous experimental conditions.

The standardized questionnaires were "rather new in kind and stand about midway between Piaget's free interrogations and the objective technique of traditional tests (Laurendeau and Pinard, 1962, p. 62)." Since the goal of the questionnaires is to elicit the underlying reasoning, they "never stop at first answers; the child is always led on to justify or explain his assertions, through a set of subquestions, counterquestions, and even suggestions which aim at probing, so to speak, the limits of his understanding (p. 62)."

Each questionnaire represents a specific area of Piaget's work. Thus, the concepts selected for study have as their objectives eliciting "the child's realism, animism, and artificialism, his explanation for mechanical and natural movement (dynamism), and finally his prediction and understanding of certain elementary physical laws (pp. 58-59.) The final list is reproduced below.

Name of Questionnaire	Objective
The concept of dream	Realism
The concept of life	Animism
The origin of night	Artificialism
The movement of clouds	Explanations of natural motions
The floating and sinking of objects	Prediction and understanding of elementary physical laws

The questionnaires were then individually administered to a stratified sample of 500 French-speaking Montreal children, ages four through twelve, as part of a battery of twenty-seven subtests.

By arranging the various types of responses into a scale of levels based on Piaget's stages, evaluative instruments were prepared for each questionnaire and the protocols were scored accordingly. "It then became possible to decide on the precausal nature of the lower stages by analyzing the content of the protocols, and to assess the generality of the phenomenon by computing the frequency of such primitive responses (pp. 93-94)."

The age of accession to the stages and substages of each concept were then computed to determine the developmental sequence of the various levels of thinking.

Although the Laurendeau and Pinard (1962) findings indicate slight differences in the age of accession to stages, they otherwise fully support Piaget's conclusions. Thus, they reaffirm the theory in their summary statement:

> To summarize, the development of the child's causal thinking consists in a progressive substitution of physicalistic interpretations for primitive beliefs. This substitution takes place as the child progresses from initial egocentrism toward adult objectivity,

> that is, as he gradually succeeds in dissociating his own self from the external universe. Since this movement of socialization or differentiation is ultimately explained by a natural process of adaptation, it constitutes a genuine phenomenon of mental evolution, which can therefore be traced in a series of stages (pp. 260-261).

This chapter identified studies related to the problem. The major study reported, viz., by Laurendeau and Pinard (1962), bears a special relation to this study in that: (a) the testing instruments and evaluative techniques designed by Laurendeau and Pinard are the basis of the methodology of this study, and (b) the results of the Laurendeau and Pinard (1962) study are used in conjunction with this study to compare the development of causal thinking in children from different cultural settings.

Chapter III

Design of the Study

For this study the Laurendeau and Pinard (1962) experimental questionnaires were administered to a sample of 150 public elementary school children. Each protocol was assessed for precausal responses, i.e. explanations which employed realism, animism, artificialism, finalism, and dynamism. The protocols were assigned to a stage of development according to the Laurendeau and Pinard (1962) evaluation scales.

The data were then analyzed for relationships between level of development and age, sex, IQ, and grade placement. Comparisons with the Laurendeau and Pinard (1962) findings were made in those areas where comparable data were available.

The Sample

The sample selected for testing consisted of 150 children enrolled in the three public elementary schools of Norwell, Massachusetts, a predominantly white, middle-class, suburban town.[1] The sample distribution reflected the proportions of the total elementary school population serviced by each school as seen in Table 1. The slight differences were due to an insufficient number of children, attending the Ella F. Osborn school, who met the age criterion. Three representative age-grade levels were chosen for comparison, each of which contained equal numbers of boys and girls.

TABLE 1

Sample Proportions by School

Name of School	Proportion of Total Elementary School Population	Proportion of Sample
Grace Farrar Cole	.49	.50
Wm. Gould Vinal	.27	.27
Ella F. Osborn	.24	.23

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[1] For a complete description of the town see the monograph City and Town: Town of Norwell published by the Massachusetts Department of Commerce and Development, Revised May 1968.

Following the criterion set by Laurendeau and Pinard (1962, p. 81), each child was within two months of his birth date on the day he was tested. After scheduling the testing dates by school and grade, a list of children, meeting the age criterion on those dates, was drawn up by entering the appropriate grade files. The children thus selected were within the limits shown in Table 2.

TABLE 2

Age-Grade Criteria for Selection

Grade	Chronological Age-Group	Age Limits	
		Lower Limit	Upper Limit
1	6.0	5 years, 10 months	6 years, 2 months
3	8.0	7 years, 10 months	8 years, 2 months
6	11.0	10 years, 10 months	11 years, 2 months

The subsequent list of subjects included those children whose whose actual ages in years, months, and days were closest to the nominal group ages of six, eight, and eleven. Thereafter, the group age was considered to be the child's age.

The final distribution by sex, age, and grade can be seen in Table 3.

TABLE 3

Distribution of Subjects by Sex, Age, and Grade

Sex	Grade 1 C.A. - 6	Grade 3 C.A. - 8	Grade 6 C.A. - 11	Totals
Girls	25	25	25	75
Boys	25	25	25	75
Totals	50	50	50	150

The range of the distribution of IQ scores was restricted since children enrolled in special classes were not considered for selection. The scores ranged from 84 to 155 with a median IQ 116, Q = 7.5 The frequency distribution is shown in Table 4. Since scores were not available for eight of the subjects, N = 142.

Three different tests had been used to measure intelligence. Grade 1 scores had been obtained on the SRA Primary Mental Ability

TABLE 4

Frequency Distribution of IQ Scores

Range	Frequency
Above 149	1
140 - 149	6
130 - 139	10
120 - 129	34
110 - 119	45
100 - 109	34
90 - 99	11
Below 90	1
N = 142	

Test; grade 3 scores had been obtained on Form A of the Otis Quick-Scoring Mental Ability Test; and grade 6 scores had been obtained on Level 3 of the Lorge-Thorndike Intelligence Test. In order to pool the different scores, the IQ scores of the Otis Quick-Scoring Mental Ability Test were converted to deviation IQ scores on the Otis-Lennon Mental Ability Test.[1] All three tests, then, had a mean IQ of 100 and a standard deviation of 16. For purposes of this study, they were considered to be equivalent.

Conditions of Testing

Each child was tested by the same examiner. Although this was a possible source of systematic error, every attempt was made to safeguard objectivity. Practice with a nonexperimental group in a different school system was used to attain uniformity of presentation and speed in recording responses.

The children were interviewed individually in a quiet room during school hours. Their responses were recorded on individual copies of the questionnaries, collated in triplicate on carbonized paper.

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[1] Conversion tables are to be found on page 51 of the Otis-Lennon Mental Ability Test Technical Handbook published by Harcourt, Brace & World, Inc., 1969.

The children were assured that this was not an academic test, that they would not be given a grade, and that their teachers would not be informed of their answers. (This assurance was important apparently to many of the children since it was often followed by an audible sigh of relief and a visible relaxation in posture).

The five standardized questionnaires were administered in one session. The average amount of time spent on the entire set of questionnaires was approximately forty-five minutes per child.

According to Laurendeau and Pinard (1962):

> The order of test administration did not have to be rigorous, because all these tests are independent and because the factor of learning has practically no effect since the solution of one problem cannot be transferred to the specific solution of another problem (p. 92).

Therefore, the questionnaires were administered in the order in which they appear in Appendix A.

Moreover, it seemed to be a fortuitous order. The questionnaire on the concept of dream is the most personal, and, appearing first, it confirmed the nonacademic nature of the testing. The last questionnaire concerning the floating and sinking of objects seemed to be the most enjoyable for the children since it required the manipulation of objects. Many of the children, particularly in the six and eight year old groups, commented on how much fun it was. Their visible enjoyment seemed to help provide motivation for the next incoming student although each child was instructed not to tell the next what had transpired in the testing room.

Evaluation of the Protocols

The protocols were evaluated independently by the examiner and two other judges. Each of the evaluators had been provided with the Laurendeau and Pinard (1962) text and with an abridged version of the scales (See Appendix B) as guides.

Practice sessions in the use of the scales were initiated before the evaluation of the experimental protocols took place.

Each protocol was considered in its entirety before assigning it to an appropriate stage of development. Instances of particular forms of precausal thinking were carefully noted in each protocol. Significant excerpts from the protocols can be found in Appendix C.

It was agreed that the same judgment by two of the three evaluators was necessary for final designation of stage of development. The results indicated close agreement on what constituted precausal thinking. Of the 750 protocols, the two-thirds agreement was independently reached on 96.4 per cent of the cases. This percentage included the 63.9 per cent of the cases which had been independently agreed upon by all three of the judges.

Total disagreement occurred on 27 protocols (3.6 per cent). In most instances, the judges agreed on the major stage of development but disagreed on the substage to which the case belonged. The judges met to consider these cases and to arrive at a decision as to stage assignment.

The most instances of disagreement occurred over the questionnaire on the concept of dream (14 cases), followed by the floating and sinking of objects (7 cases), and the origin of night (6 cases).

Statistical Procedure

The data were reported in terms of frequencies in discrete categories. Therefore, nonparametric techniques were appropriate for statistical analyses. In general, the chi square analysis of distribution applied to the data because it is a useful method of determining the significance of differences among independent groups when other than interval measurement is involved (Siegel, 1956).

Since Hypothesis 1 was not concerned with differences, the frequencies were handled descriptively to determine the amounts and kinds of precausal responses found in this sample. Chi square analysis was employed to test Hypotheses 2 through 13 to determine whether the differences between the experimentally observed frequencies and those expected from probability theory could be attributed to chance alone. Stage 0 subjects were not included in the chi square analyses since for each questionnaire Stage 0 indicates incomprehension or refusal.

Where expected frequencies of less than 5.0 were encountered, it was necessary to combine adjacent cells. The combinations were always substages of Stage 1 and/or Stage 2 since both of these stages have precausality in common.

Although the Laurendeau and Pinard (1962) sample included children ages four through twelve, the frequencies, for each age group, differentiated by sex, were reported for each stage of every questionnaire. Thus, it was possible to abstract the data for comparison of the Canadian and American sample by sex and age.

The Friedman two-way analysis of variance was employed to test Hypothesis 14. Although this technique calls for matched samples, "the matching may be achieved by studying the same group of subjects under each of k conditions (Siegel, 1956, p. 166)." In this instance, the same group of subjects was studied under the conditions of five different concepts involving causal thinking.

The data were cast in a two-way table having 150 rows and 5 columns. The rows represented each subject in the sample and the columns represented the five concepts tested by the questionnaires.

Since the data for the Friedman test are ranks, the scores in each row were ranked separately. The scores for ranking were the stages of development attained for each questionnaire. However, since each questionnaire had a different number of substages only the major stages were considered. So, for instance, if a subject was scored Stage 1A on the questionnaire on the origin of night, his score was considered to be Stage 1 for purposes of this test. An example of the transformation is shown below for protocol number 33:

	Concept (abbreviated title)				
	Dream	Life	Night	Clouds	Floating and Sinking
Observed stage	0	1	3B	3A	2B
Modified stage	0	1	3	3	2
Rank	1	2	4.5	4.5	3

This procedure was followed for each of the 150 subjects.

According to Siegel (1956), "if the subjects' scores were independent of the conditions, . . . the rank totals for the various columns would be about equal. If the subjects' scores were dependent on the conditions (if H_o were false), then the rank totals would vary from one column to another (p. 167)." The ranks in each column were totalled and the Friedman test was then applied to determine whether the rank totals differed significantly. The statistic computed for the Friedman test is denoted Xr^2. When the number of rows and/or columns is not too small, Xr^2 is distributed approximately as chi square with $df = k - 1$ (Siegel, 1956).

The .01 level of significance was used as the basis for the rejection or acceptance of the null hypotheses since this was the level employed by Laurendeau and Pinard (1962). All of the tests of significance were computed concurrently and independently by two doctoral candidates in educational research in order to cross-validate the results.

Chapter IV

Analysis of Data

The administration of the Laurendeau and Pinard (1962) questionnaires to 150 eleven, eight, and six year old, American, public-school children yielded 750 protocols for evaluation. Each protocol was assigned to a stage of development by three judges using the Laurendeau and Pinard (1962) scales.

For analytical purposes, the data then were assembled by frequency of occurrence of (a) the various modes of precausal thinking, and (b) the various stages of development for each concept tested according to the sex, age, grade, and IQ of the S's.

The order of presentation of results follows that of the questions raised in Chapter I (p. 2). In each instance the results of the present study are shown first. Where data are available, comparisons with the Laurendeau and Pinard (1962) results are then made.

For ease of presentation the Laurendeau and Pinard (1962) sample is hereafter designated "Canadian" and the sample of this study is designated "American."

Question 1. Evidence of Precausal Thinking

The data confirm the existence of precausal modes of thinking.

Table 5 indicates the pervasiveness of precausal thinking in the responses and shows that animism, artificialism, and finalism are the most frequently used modes. Dynamism and realism are used with about equal frequency. However, dynamism was elicited by four of the five questionnaires and realism was confined to the concept of dream.

That some children were persistent in the use of a particular mode of percausal thinking can be seen in Table 6. For example, of the 64 children who resorted to artificialism, 29 do so in one questionnaire only, 16 in two, 15 in three, and 4 in four. On the whole the table shows that 21.5 per cent of the children used the same type of precausal thinking in more than one questionnaire.

The proportion of S's who actually employed the various forms of precausal thinking can also be determined from the data in Table 6. Out of a total sample of 150 children 27.3 per cent used realism at least once; 48 per cent used animism; 42.7 per cent used artificialism; 36.7 per cent used finalism; and 25.3 per cent used dynamism.

TABLE 5

Frequency of Occurrence of Various Modes of Precausal Thinking in Each One of the Questionnaires

Questionnaire	Mode of Precausal Thinking				
	Realism	Animism	Artificialism	Finalism	Dynamism
Concept of Dream	41	0	43	10	0
Concept of Life	0	73	6	1	3
Origin of Night	0	0	36	48	1
Movement of Clouds	0	12	34	0	25
Floating and Sinking	0	0	3	3	13
Total Frequency of Occurrence	41	85	122	62	42

TABLE 6

Distribution of Subjects as to the Number of Questionnaires in Which Various Modes of Precausal Thinking Are Manifested

Mode of Precausal Thinking	Number of Questionnaires				
	4	3	2	1	Total
Realism	0	0	0	41	41
Animism	0	0	11	61	72
Artificialism	4	15	16	29	64
Finalism	0	0	8	47	55
Dynamism	0	0	4	34	38

Fifty-five per cent of the children in this sample used more than one mode of precausal thinking during the examination as can be seen in Table 7. Eighty per cent of the sample expressed their beliefs in at least one precausal mode. Six year old children tended to use more modes of precausality than eight or eleven year old children.

TABLE 7

Distribution of Subjects According to Number of Modes of Precausality Resorted to in the Whole Series of Questionnaires

		Number of Modes of Precausality											
Age	N	0	1	2	3	4	5	0	1	2	3	4	5
		Frequencies						Percentages					
11	50	18	18	8	5	1	0	36	36	16	10	2	0
8	50	10	12	16	9	3	0	20	24	32	18	6	0
6	50	2	7	15	14	10	2	4	14	30	28	20	4
Total	150	30	37	39	28	14	2						
Over-All Percentages								20	25	26	19	9	1

Direct comparison with the Laurendeau and Pinard (1962) results could not be made since their data included the precausal responses of children ages four through twelve. The contributions of each group were not indicated.

In general, Laurendeau and Pinard (1962) reported greater proportions of precausal modes of thinking. However, since 150 children in their sample of five hundred were below the age of six, such responses were expected. This younger group would also account for the fact that 40 per cent of their sample used the same mode of precausal thinking in more than one questionnaire whereas only 21.5 per cent of this sample did so.

Nevertheless, both studies agree that: (a) animism, artificialism and finalism are the most frequently used modes of precausal thinking, (b) younger children tend to use a greater number of precausal modes than do older children, and (c) use of precausal modes of thinking decreases with age.

Question 2. The Effect of Religious Instruction

Ezer (1961) contended that children attending all-day religious schools would offer more animistic and/or anthropomorphic explanations to problems involving physical causality than would children attending public schools. His findings gave rise to the following null hypothesis:

H_o: There is no difference in the frequency of animistic explanations offered by children who attend all-day Catholic schools and children who attend public schools as measured by the Laurendeau and Pinard questionnaire on the concept of life.

Since the questionnaire on the concept of life was specifically designed to elicit animism, the frequency of animistic responses of the Canadian sample to this questionnaire was compared with that of the American sample. Table 8 shows the observed and expected frequencies, and chi square value for the comparison of the Canadian and American samples on the frequency of animistic and nonanimistic responses. The frequency of animistic responses was obtained by pooling the number of Stage 1 and Stage 2 subjects. The frequency of nonanimistic responses is equal to that of the Stage 3 subjects.

TABLE 8

Comparison of the Canadian and American Samples on the Frequency of Animistic and Nonanimistic Responses

Subjects	Animistic	Nonanimistic	Totals
Canadian	72 (68.1)	60 (63.9)	132
American	73 (76.9)	76 (72.1)	149
Totals	145	136	381

df=1, X^2=.66
$p > .01$

The null hypothesis of no difference was accepted. There was no evidence to support Ezer's (1961) conclusion in these data.

However, there appears to be some potential support for Ezer's (1961) hypothesis in other data gathered from this set of questionnaires. First, Laurendeau and Pinard (1962) report that 64.4 per cent of their total sample used animistic terms at least once during the examination. In this study only 48.0 per cent of the sample used animism. Of course, the specific age-group contributions would be needed to determine if a significant difference exists for ages six, eight, and eleven.

Second, it seems reasonable to assume that religious training would affect the amount of divine artificialism offered in explanations of physical causality. Laurendeau and Pinard (1962) report that 230 of the 256 instances of artificialism (89.8 per cent) were attributable to divine artificialism, i.e., God was the agent of causality. In this study 84 of the 122 instances of artificialism (68.9 per cent) relate to divine artificialism.

Table 9 indicates the observed and expected frequencies, and chi square value for the comparison of Catholic and public-school samples on the frequency of usage of divine artificialism and other types of artificialism.

TABLE 9

Comparison of Catholic and Public School Samples on the Frequency of Usage of Divine Artificialism and other Types of Artificialism

Subjects	Divine Artificialism	Other Artificialism	Totals
Catholic School	230 (212.7)	26 (43.3)	256
Public School	84 (101.3)	38 (20.7)	122
Totals	314	64	378

df=1, X^2=25.73
$p < .01$

There is a significant difference between the two groups in the use of divine artificialism. Since Laurendeau and Pinard (1962) found a preponderance of divine artificialism at ages six through eight, the difference in frequencies noted above would appear to reflect a real difference between Catholic school and public school children.

Question 3. Sex Differences

A. Modes of Precausal Thinking: American Boys and Girls

H_o: There is no difference between boys and girls in the frequency of usage of realism, animism, artificialism, finalism, and dynamism.

Table 10 shows the observed and expected frequencies, and chi square value for the comparison of the frequency with which boys and girls of this sample manifested the above forms of precausal thinking.

TABLE 10

Comparison of Boys and Girls on the Frequency of Usage of the Various Forms of Precausal Thinking

Subjects	Realism	Animism	Artificialism	Finalism	Dynamism	Totals
Girls	14 (18.9)	39 (35.9)	32 (31.9)	26 (26.4)	21 (18.9)	132
Boys	24 (19.1)	33 (36.1)	32 (32.1)	27 (26.6)	17 (19.1)	133
Totals	38	72	64	53	38	265

df=4, X^2=3.57
p> .01

There is no significant difference. From the data in Table 10 the hypothesis is accepted. Boys and girls use the various modes of precausal thinking with equal frequency.

B. Developmental Levels: American Boys and Girls

H_o: There is no difference between boys and girls in the level of development attained for each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

Table 11 presents the observed and expected frequencies, and chi square value for the comparison of the developmental levels of boys and girls on the concept of dream.

TABLE 11

Comparison of Sex Differences on the Questionnaire on Dream

Subjects	Stages 1-2A-2B	Stage 2C	Stage 3A	Stage 3B	Totals
Girls	11 (14.4)	6 (5.0)	12 (14.9)	45 (39.7)	74
Boys	18 (14.6)	4 (5.0)	18 (15.1)	35 (40.3)	75
Totals	29	10	30	80	149

df=3, X^2=4.53
p > .01

In the evaluation of the protocols for the concept of dream,[1] stage 1 represents a belief in the external reality of dreams as objects which are thought to be caused by someone other than the subject. Stage 2 and its substages represent a progressive transition period during which the dream becomes interiorized and is the product of the dreamer. However, the child still vacillates between some of the internal and external elements. In stage 3 the origin and location of the dream are definitely internal. The dream is caused by the dreamer, and has no material substance to it.

Only three girls and one boy were assigned to stage 1; fourteen girls and twenty-one boys were in stage 2; and fifty-seven girls and fifty-three boys were designated stage 3. As Table 11 indicates, there is no significant difference between boys and girls. The null hypothesis for the concept of dream is accepted at the .01 level of significance.

The comparison of sex differences on the questionnaire on life is shown in Table 12.

Stage 1 subjects attribute life to one or more inanimate objects. The primary criteria that they use are anthropomorphism, and the usefulness or movement of objects.

TABLE 12

Comparison of Sex Differences on the Questionnaire on Life

Subjects	Stage 1	Stage 2	Stage 3	Total
Girls	20 (23.7)	18 (13.1)	37 (38.3)	75
Boys	27 (23.3)	8 (12.9)	39 (37.8)	74
Totals	47	26	76	149

df=2, $X^2=4.94$
$p > .01$

Stage 2 subjects also attribute life to some inanimate objects but they distinguish between objects which must be moved and objects which move by themselves. Animistic thinking disappears in the third stage. None of the inanimate objects are considered to be alive for any reason.

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[1] For purposes of explication only the major stages in the development of each concept are presented in this section. A full description of all the substages appears in Appendix B.

The data in Table 12 shows no significant differences in the developmental levels of boys and girls. The null hypothesis is accepted at the .01 level of significance for the concept of life.

Table 13 compares the sex differences on the questionnaire on the origin of night.

TABLE 13

Comparison of Sex Differences on the Questionnaire on the Origin of Night

Subjects	Stage 1A	Stage 1B	Stage 2	Stage 3A	Stage 3B	Totals
Girls	7 (5.5)	12 (10.5)	8 (7.0)	5 (8.0)	42 (43.0)	74
Boys	4 (5.5)	9 (10.5)	6 (7.0)	11 (8.0)	44 (43.0)	74
Totals	11	21	14	16	86	148

df=4, $X^2=3.83$
$p > .01$

The subjects in stage 1 resort to finalism and/or artificialism to explain the origin of night. In stage 2 artificialism is interspersed with physical elements and is usually accompanied by finalistic responses. Stage 3 subjects, while not always scientifically correct, offer explanations in which the origin of night is caused by natural elements.

The null hypothesis of no difference in the developmental levels of boys and girls is accepted at the .01 level of significance for the concept of the origin of night.

The sex differences on the questionnaire on the movement of clouds are compared in Table 14.

TABLE 14

Comparison of Sex Differences on the Questionnaire on the Movement of Clouds

Subjects	Stage 1	Stage 2	Stage 3A	Stage 3B	Totals
Girls	8 (5.3)	9 (8.3)	14 (18.0)	37 (36.4)	68
Boys	3 (5.7)	8 (8.7)	23 (19.0)	38 (38.6)	72
Totals	11	17	37	75	140

df=3, $X^2=4.42$
$p > .01$

Human or divine action causes the movement of clouds according to stage 1 subjects while the cooperation of a natural agent is added to the explanations of stage 2 subjects. Most of the stage 3 subjects, on the other hand, designate the wind as the mover of the clouds, occasionally explaining the wind's role in a precausal way. Others regard the movement of the wind as illusive and explain the reason for the illusion in scientific terms.

There were no significant differences in the developmental levels of boys and girls on this concept although there were fewer boys in stage 1. The null hypothesis is accepted for the concept of the movement of clouds at the .01 level of significance.

Table 15 indicates the observed and expected frequencies, and chi square value for the comparison of the developmental levels of boys and girls on the concept of the floating and sinking of objects.

In the evaluation of the responses to this questionnaire, stage 1 subjects account for the floating and sinking of objects with finalistic, animistic, or dynamistic reasons. Stage 2 subjects supply physical explanations but use them incorrectly. Physical, coherent explanations are given by stage 3 subjects. Stage 3B is reserved for subjects who formulate the exact principle of the floating of bodies.

One girl from the whole sample was designated stage 1. There were no stage 3B subjects. This finding agrees with the Laurendeau and Pinard (1962) finding in which only 2 out of 498 S's were designated stage 3B. The entire American sample was overwhelmingly stage 2. However, there was a significant difference

TABLE 15

Comparison of Sex Differences on the Questionnaire on the Floating and Sinking of Objects

Subjects	Stages 1 - 2A	Stage 2B	Stages 3A-3B	Totals
Girls	29 (19.5)	34 (38.0)	12 (17.5)	75
Boys	10 (19.5)	42 (38.0)	23 (17.5)	75
Totals	39	76	35	150

df=2, $X^2=13.56$
$p < .01$

between the developmental levels of boys and girls. Therefore, the null hypothesis is rejected at the .01 level of significance for the concept of the floating and sinking of objects.

In summary, the data show that there are no significant differences in the developmental levels of boys and girls for the concepts of dream, life, the origin of night, and the movement of clouds. There is a significant difference between boys and girls on the concept of the floating and sinking of objects.

Laurendeau and Pinard (1962) found no significant differences on any of the questionnaires when the chi square values included all age groups. However, on the questionnaire on floating and sinking, a significant difference at age eleven in favor of boys appeared. At all age levels more boys than girls attained stage 3A on the floating and sinking of objects. Table 15 indicates that the same holds true for this sample where twice as many boys as girls were in stage 3A.

Observation of the phenomena of floating and sinking is more accessible through concrete experience than any of the other phenomena investigated. The difference between boys and girls may be related to interest and experience factors leading to the boys having more concrete experiences with the floating and sinking of objects.

C. Developmental Levels: Canadian and American Girls

H_o: There is no difference between Canadian and American girls in the level of development attained for each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

A comparison of Canadian and American girls on the questionnaire on dream is presented in Table 16.

There is a significant difference between the Canadian and American girls on the concept of dream. More than half of the American girls were at stage 3B which constitutes a perfect explanation of the dream, whereas less than one-third of the Canadian girls were able to attain this stage. The null hypothesis is rejected at the .01 level of significance for the concept of dream.

TABLE 16

Comparison of Canadian and American Girls on the Questionnaire on Dream

Subjects	Stages 1-2A-2B-2C	Stage 3A	Stage 3B	Totals
Canadian Girls	24 (20.2)	26 (18.7)	22 (33.0)	72
American Girls	17 (20.9)	12 (19.3)	45 (40.0)	74
Totals	41	38	67	146

df=2, X^2=14.22
$p < .01$

Table 17 presents the data for the comparison of the Canadian and American girls on the questionnaire on life.

Although more American girls than Canadian girls were free of animistic thinking, stage 3, the differences between the developmental levels of the two groups is not significant. The null hypothesis is accepted at the .01 level of significance for the concept of life.

TABLE 17

Comparison of Canadian and American Girls on the Questionnaire on Life

Subjects	Stage 1	Stage 2	Stage 3	Totals
Canadian Girls	26 (21.2)	12 (13.8)	26 (29.0)	64
American Girls	20 (24.8)	18 (16.2)	37 (34.0)	75
Totals	46	30	63	139

df=2, X^2=3.05
$p > .01$

There is, however, a significant difference between Canadian and American girls on the questionnaire on the origin of night as is seen in Table 18.

The major difference occurred in the frequency of subjects at stage 3B. Three and a half times more American girls than Canadian girls were able to explain the origin of night in physicalistic terms freed from any precausality. The null hypothesis is rejected at the .01 level for the concept of the origin of night.

TABLE 18

Comparison of Canadian and American Girls on the Questionnaire on the Origin of Night

Subjects	Stages 1A-1B	Stage 2	Stage 3A	Stage 3B	Totals
Canadian Girls	21 (20.0)	27 (17.5)	14 (9.5)	12 (27.0)	74
American Girls	19 (20.0)	8 (17.5)	5 (9.5)	42 (27.0)	74
Totals	40	35	19	54	148

df=3, X^2=31.34
$p < .01$

Data for the comparison of the Canadian and American girls on the questionnaire on the movement of clouds is given in Table 19.

TABLE 19

Comparison of Canadian and American Girls on the Questionnaire on the Movement of Clouds

Subjects	Stage 1	Stage 2	Stage 3A	Stage 3B	Totals
Canadian Girls	35 (21.5)	8 (8.5)	14 (14.0)	11 (24.0)	68
American Girls	8 (21.5)	9 (8.5)	14 (14.0)	37 (24.0)	68
Totals	43	17	28	48	136

df=3, X^2=31.10
$p < .01$

The proportion of subjects appearing in stages 1 and 3B are clearly reversed for the Canadian and American girls. More than half of the Canadian girls attributed the movement of clouds to human or divine action and thus were designated stage 1. On the other hand, more than half of the American girls gave the correct explanation freed from any precausal thinking and so appear in stage 3B. The difference in developmental levels is statistically significant. The null hypothesis is rejected at the .01 level for the concept of the movement of clouds.

A comparison of the Canadian and American girls on the questionnaire on the floating and sinking of objects appears in Table 20.

Both samples had relatively few subjects in stage 1, five in the Canadian sample and one in the American sample. Neither sample had any stage 3B subjects. It would appear that more Canadian girls were able to give the correct physical explanations for the floating and sinking of objects as denoted by their stage 3A designation. However, many of the American girls in stage 2B probably belong in stage 3A. This discrepancy will be explained later in this chapter.

There is a significant difference in the developmental levels of the Canadian and American girls. The null hypothesis is rejected at the .01 level of significance for the concept of the floating and sinking of objects.

TABLE 20

Comparison of Canadian and American Girls on the Questionnaire on the Floating and Sinking of Objects

Subjects	Stages 1 - 2A	Stage 2B	Stages 3A-3B	Totals
Canadian Girls	37 (32.6)	15 (24.2)	21 (16.3)	73
American Girls	29 (33.4)	34 (24.8)	12 (16.7)	75
Totals	66	49	33	148

df=2, $X^2=10.77$
$p < .01$

D. Developmental Levels: Canadian and American Boys

H_o: There is no difference between Canadian and American boys in the level of development attained for each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

Table 21 presents a comparison of Canadian and American boys on the questionnaire on dream.

More American than Canadian boys were able to give perfect explanations of the dream. It should be noted that, although it was necessary to combine stages 1 through 2C, only one of the twenty-two American boys was in stage 1 as compared to three of the twelve Canadian boys. As Table 21 indicates, the difference between the Canadian and American boys is significant. The null hypothesis is rejected for the concept of dream.

The difference between the Canadian and American boys on the concept of life is not significant as is shown in Table 22.

TABLE 21

Comparison of Canadian and American Boys on the Questionnaire on Dream

Subjects	Stages 1-2A-2B-2C	Stage 3A	Stage 3B	Totals
Canadian Boys	12 (16.7)	39 (27.9)	21 (27.4)	72
American Boys	22 (17.3)	18 (29.1)	35 (28.6)	75
Totals	34	57	56	147

df=2, X^2=14.12
$p < .01$

TABLE 22

Comparison of Canadian and American Boys on the Questionnaire on Life

Subjects	Stage 1	Stage 2	Stage 3	Totals
Canadian Boys	21 (23.0)	13 (10.0)	34 (35.0)	68
American Boys	27 (25.0)	8 (11.0)	39 (38.0)	74
Totals	48	21	73	142

df=2, X^2=2.03
$p > .01$

Although a greater proportion of American than Canadian boys were free of animistic thinking the difference between the groups can be attributed to chance. The null hypothesis is accepted at the .01 level for the concept of life.

The observed and expected frequencies, and the chi square value for the comparison of Canadian and American boys on the questionnaire on the origin of night is presented in Table 23.

TABLE 23

Comparison of Canadian and American Boys on the Questionnaire on the Origin of Night

Subjects	Stages 1A-1B	Stage 2	Stage 3A	Stage 3B	Totals
Canadian Boys	16 (14.7)	30 (18.2)	9 (10.1)	21 (32.9)	76
American Boys	13 (14.3)	6 (17.8)	11 (9.9)	44 (32.1)	74
Totals	29	36	20	65	150

df=3, X^2=24.63
$p < .01$

More Canadian than American boys offered precausal responses to the questionnaire on the origin of night. Twice as many American boys had reached the final stage of development, completely free of precausal thinking. This difference was significant. So, the null hypothesis is rejected at the .01 level for the concept of the origin of night.

A comparison of Canadian and American boys on the questionnaire on the movement of clouds is shown in Table 24

TABLE 24

Comparison of Canadian and American Boys on the Questionnaire on the Movement of Clouds

Subjects	Stage 1	Stage 2	Stage 3A	Stage 3B	Totals
Canadian Boys	32 (17.9)	7 (7.7)	18 (20.9)	18 (28.6)	75
American Boys	3 (17.1)	8 (7.3)	23 (20.1)	38 (27.4)	72
Totals	35	15	41	56	147

df=3, X^2=31.80
$p < .01$

The pattern that emerged for the Canadian and American girls on this concept is seen again in the comparison of the Canadian and American boys. The proportion of subjects appearing in stages 1 and 3B are reversed. The null hypothesis is rejected for the concept of the movement of clouds since the difference in developmental levels is significant at the .01 level.

Table 25 indicates a statistically significant difference between the Canadian and American boys on the questionnaire on the floating and sinking of objects.

TABLE 25

Comparison of Canadian and American Boys on the Questionnaire on the Floating and Sinking of Objects

Subjects	Stages 1 - 2A	Stage 2B	Stages 3A-3B	Totals
Canadian Boys	19 (14.5)	18 (30.0)	38 (30.5)	75
American Boys	10 (14.5)	42 (30.0)	23 (30.5)	75
Totals	29	60	61	150

df=2, X^2=16.08
$p < .01$

There are five substages in the development of the concept of floating and sinking. However, no Canadian or American boys were in stages 1 or 3B which represent the extremes of precausal thinking and perfect explanation. The majority of the American boys appear in stage 2B. As was noted for the American girls, some of these boys probably belong in stage 3A which will be explained later in the chapter.

The differences as stated in Table 25 are significant at the .01 level. The null hypothesis is rejected for the concept of the floating and sinking of objects.

In summary, it appears that the sex of the child is not a source of difference when subjects are from the same sample. However, some differences are noted when the subjects are compared with the same-sex subjects in another sample, i.e., American girls are more like American boys than Canadian girls in the stages of development attained in response to the Laurendeau and Pinard (1962) questionnaires, and likewise, the responses of American boys to the Laurendeau and Pinard (1962) questionnaires and more like American girl's than Canadian boy's.

Question 4. Age Differences

A. American Sample

H_o: There is no difference in the level of development attained by eleven, eight, and six-year-old children on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

Table 26 shows the comparison of eleven, eight, and six-year-old children on the questionnaire on dream.

Almost half of the six-year-old children gave evidence of some precausal thinking in their explanations of the dream phenomenon. Four of the six-year-old children were in stage 1 and four were in stage 2A. There were no eight or eleven-year-old children in either of these stages and there were fewer than would be expected in stages 2B and 2C. The frequency of occurrence at stage 3B indicates a regular increase with increasing age.

TABLE 26

Comparison of Eleven, Eight, and Six-Year-Old Children on the Questionnaire on Dream

Age of Subjects	Stages 1-2A-2B-2C	Stage 3A	Stage 3B	Totals
11.0	10 (13.1)	2 (10.1)	38 (26.9)	50
8.0	7 (13.1)	13 (10.1)	30 (26.9)	50
6.0	22 (12.8)	15 (9.9)	12 (26.3)	49
Totals	39	30	80	149

df=4, X^2=32.90
$p < .01$

The difference in the level of development sttained by eleven, eight, and six-year-old children is statistically significant. The null hypothesis is rejected for the concept of dream.

Frequency of occurence at stages 1 and 2 on the questionnaire on life proceeds as predicted by Piagetian theory, i.e., there are more six-year-old than eight or eleven-year-old children at stage 1 and more eleven-year-old than six or eight-year-old children at stage 2. However, there are fewer eleven-year-old than eight-year-old children at stage 3 as is shown in Table 27.

TABLE 27

Comparison of Eleven, Eight, and Six-Year-Old Children on the Questionnaire on Life

Age of Subjects	Stage 1	Stage 2	Stage 3	Totals
11.0	11 (15.8)	17 (8.7)	22 (25.5)	50
8.0	12 (15.8)	5 (8.7)	33 (25.5)	50
6.0	24 (15.5)	4 (8.6)	21 (25.0)	49
Totals	47	26	76	149

df=4, X^2=22.25
$p < .01$

The drop in frequency of eleven-year-old children at stage 3 cannot be explained by theory. But, it should be noted that Laurendeau and Pinard (1962) found fewer twelve-year-old than ten and eleven-year-old children at stage 3 on the concept of life. They prefer to assume that the drop is due to sampling error (Laurendeau and Pinard, 1962, p. 155). But, while sampling error is always a possibility, the drop in frequency at stage 3 for eleven and twelve-year-old children might also constitute a real trend. If this is so, then, the source of variation must be sought elsewhere.

One possibility might be found in the timing of presentation of the unit on life in the science curriculum. For example, in the Norwell schools the formal unit describing the criteria for living things is presented in grade 5 which the eleven-year-old children had completed just three months prior to answering the questionnaire on life. Many of the six and eight-year-old children apparently had grasped intuitively the concept of life as can be seen in the stage 3 column of Table 27. It may be that direct teaching of specific criteria for judgment of "aliveness" temporarily interferes with the intuitive model of some children. Of course, this hypothesis would have to be tested.

Nevertheless, the null hypothesis is rejected for the concept of life since the difference in the level of development attained by eleven, eight, and six-year-old children is statistically significant.

Table 28 presents the observed and expected frequencies, and the chi square value for the comparison of the three age groups on the questionnaire on the origin of night.

TABLE 28

Comparison of Eleven, Eight, and Six-Year-Old Children on the Questionnaire on Origin of Night

Age of Subjects	Stages 1A-1B-2	Stage 3A	Stage 3B	Totals
11.0	1 (15.5)	1 (5.4)	48 (29.0)	50
8.0	12 (14.9)	11 (5.2)	25 (27.9)	48
6.0	33 (15.5)	4 (5.4)	13 (29.1)	50
Totals	46	16	86	148

df=4, X^2=65.78
$p < .01$

Over two-thirds of the American sample attained stage 3 on the concept of the origin of night. However, only 34 per cent of the six-year-old children were at stage 3 while 75 per cent of the eight-year-old and 98 per cent of the eleven-year-old children attained stage 3. The ranking was reversed for the stages characterized by precausal thinking, stages 1 and 2.

The difference between age groups is significant at the .01 level. The null hypothesis is rejected for the concept of the origin of night.

The data for the comparison of eleven, eight, and six-year-old children on the concept of the movement of clouds is presented in Table 29.

TABLE 29

Comparison of Eleven, Eight, and Six-Year-Old Children on the Questionnaire on the Movement of Clouds

Age of Subjects	Stages 1-2	Stage 3A	Stage 3B	Totals
11.0	4 (9.4)	6 (12.4)	37 (25.2)	47
8.0	7 (9.4)	15 (12.4)	25 (25.2)	47
6.0	17 (9.2)	16 (12.2)	13 (24.6)	46
Totals	28	37	75	140

df=4, X^2=26.45
$p < .01$

The distribution in Table 29 ideally illustrates the underlying theory of the development of the concept of physical causality. In stages 1 and 2 which are characterized by precausal thinking the observed frequency of six-year-old subjects exceeds the expected frequency; the observed frequency of eight-year-old subjects is close to the expected frequency; and the observed frequency of eleven-year-old subjects is less than the expected frequency. In other words, there is a decrease in precausal responses with an increase in the age of the subjects. Exactly the reverse situation is true in stage 3B which is completely devoid of precausal thinking. In stage 3B the increase in chronological age is paralleled by an increase in causal responses.

The null hypothesis is rejected for the concept of the movement of clouds. The difference in development attained by eleven, eight, and six-year-old children is significant at the .01 level.

There is also a significant difference in the level of development attained by eleven, eight, and six-year-old children on the concept of the floating and sinking of objects. Table 30 presents the data for comparison.

Although no subjects were able to formulate the exact principle of the floating and sinking of objects, thirty-five of the subjects responded with coherent, physical explanations and were designated stage 3A. As was expected, most of the children in stage 3A were eleven-years-old and most of the children in the lower stages were six-years old. As was noted before, some of the children in stage 2B probably belong in stage 3A.

TABLE 30

Comparison of Eleven, Eight, and Six-Year-Old Children on the Questionnaire on the Floating and Sinking of Objects

Age of Subjects	Stages 1-2A	Stage 2B	Stages 3A-3B	Totals
11.0	2 (13.0)	23 (25.3)	25 (11.7)	50
8.0	15 (13.0)	27 (25.3)	8 (11.7)	50
6.0	22 (13.0)	26 (25.3)	2 (11.7)	50
Totals	39	79	35	150

df=4, X^2=40.59
$p < .01$

However, the difference in level of development attained by eleven, eight, and six-year-old children as shown in Table 30 is significant at the .01 level. The null hypothesis is rejected for the concept of the floating and sinking of objects.

There appears to be a definite relationship between age of the subject and stage of development attained on each of the concepts tested. These findings are in agreement with the findings of the Laurendeau and Pinard (1962) study.

B. Differences at Each Age Level: Canadian and American Samples

Age 11. H_o: There is no difference between eleven-year-old Canadian and American children in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

The level of development attained by eleven-year-old Canadian and American children on the concept of dream is compared in Table 31.

There were no Canadian or American eleven-year-old children at stages 1 or 2A. While almost half of the Canadian eleven-year-old children still showed traces of precausal thinking at stage 3A, three-fourths of the American eleven-year-old children gave perfect explanations of the dream. This difference is probably due to the attenuation of divine artificialism that was noted in the Catholic-school children.

The difference between the eleven-year-old Canadian and American children is statistically significant. The null hypothesis is rejected for the concept of dream.

TABLE 31

Comparison of Eleven-Year-Old Canadian and American Children on the Questionnaire on Dream

Subjects	Stages 1-2A-2B-2C	Stage 3A	Stage 3B	Total
Canadian	3 (6.5)	23 (12.5)	24 (31.0)	50
American	10 (6.5)	2 (12.5)	38 (31.0)	50
Totals	13	25	62	100

df=2, $X^2=24.57$
$p < .01$

Data for comparison of eleven-year-old Canadian and American children on the questionnaire on life is presented in Table 32.

TABLE 32

Comparison of Eleven-Year-Old Canadian and American Children on the Questionnaire on Life

Subjects	Stage 1	Stage 2	Stage 3	Totals
Canadian	9 (10.0)	12 (14.5)	29 (25.5)	50
American	11 (10.0)	17 (14.5)	22 (25.5)	50
Totals	20	29	51	100

df=2, X^2=2.02
$p > .01$

The drop in frequency of eleven-year-old American children at stage 3 was commented on in section A of Question 4. It was hypothesized that the children were unable to assimilate the formal criteria for "aliveness" into their intuitive concepts.

However, the difference in development between the eleven-year-old Canadian and American children is not statistically significant. The null hypothesis is accepted for the concept of life.

Table 33 presents the data for comparison of the eleven-year-old Canadian and American children on the questionnaire on the origin of night.

All but two of the eleven-year-old American children explained the origin of night in physical, causal terms. The null hypothesis is rejected for the concept of the origin of night since the difference between the developmental levels of eleven-year-old Canadian and American children is significant at the .01 level.

A significant difference was also found in the comparison of eleven-year-old Canadian and American children on the questionnaire on the movement of clouds shown in Table 34.

The null hypothesis is rejected for the concept of the movement of clouds.

TABLE 33

Comparison of Eleven-Year-Old Canadian and American Children on the Questionnaire on the Origin of Night

Subjects	Stages 1A-1B-2	Stage 3A	Stage 3B	Totals
Canadian	14 (7.5)	10 (5.5)	26 (37.0)	50
American	1 (7.5)	1 (5.5)	48 (37.0)	50
Totals	15	11	74	100

df=2, X^2=25.17
$p < .01$

TABLE 34

Comparison of Eleven-Year-Old Canadian and American Children on the Questionnaire on the Movement of Clouds

Subjects	Stages 1 - 2	Stage 3A	Stage 3B	Totals
Canadian	14 (9.3)	13 (9.8)	23 (30.9)	50
American	4 (8.7)	6 (9.2)	37 (29.1)	47
Totals	18	19	60	97

df=2, X^2=11.32
$p < .01$

The American children in all three age groups consistently offered more causal responses to the questionnaire on the movement of clouds than did the Canadian children. Some possible reasons for this situation will be offered after the presentation of the data for the six-year-old children.

A comparison of the eleven-year-old Canadian and American children on the questionnaire on the floating and sinking of objects is shown in Table 35.

TABLE 35

Comparison of Eleven-Year-Old Canadian and American Children on the Questionnaire on the Floating and Sinking of Objects

Subjects	Stages 1 - 2A	Stage 2B	Stage 3A-3B	Totals
Canadian	8 (5.0)	8 (15.5)	34 (29.5)	50
American	2 (5.0)	23 (15.5)	25 (29.5)	50
Totals	10	31	59	100

df=2, X^2=12.23
$p < .01$

None of the eleven-year-old subjects attained stage 3B. Only one subject, a Canadian girl, was in stage 1. The distribution clusters around stages 2B and 3A with more eleven-year-old Canadian children than American children appearing in stage 3A. The difference between the groups is significant at the .01 level. The null hypothesis is rejected for the concept of the floating and sinking of objects.

Age 8. H_o: There is no difference between eight-year-old Canadian and American children in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

Table 36 shows the result of the comparison of eight-year-old Canadian and American children on the questionnaire on dream.

None of the eight-year-old children in either sample was at stage 1. The majority of both groups reached stage 3 but almost twice as many eight-year-old Canadian children occasionally gave a precausal response accounting for the stage 3A evaluation. However, the difference between the groups is not significant at the .01 level. So, the null hypothesis is accepted for the concept of dream.

TABLE 36

Comparison of Eight-Year-Old Canadian and American Children on the Questionnaire on Dream

Subjects	Stages 1-2A-2B-2C	Stage 3A	Stage 3B	Totals
Canadian	9 (8.0)	25 (19.0)	16 (23.0)	50
American	7 (8.0)	13 (19.0)	30 (23.0)	50
Totals	16	38	46	100

df=2, X^2=8.30
$p > .01$

Comparison of the eight-year-old Canadian and American children on the questionnaire on life is shown in Table 37.

TABLE 37

Comparison of Eight-Year-Old Canadian and American Children on the Questionnaire on Life

Subjects	Stage 1	Stage 2	Stage 3	Totals
Canadian	18 (14.2)	7 (5.68)	20 (25.1)	45
American	12 (15.8)	5 (6.3)	33 (27.9)	50
Totals	30	12	53	95

df=2, X^2=4.47
$p > .01$

Fewer eight-year-old American subjects attributed life to inanimate objects. But, the difference between the eight-year-old Canadian and American children is not significant. The null hypothesis is accepted for the concept of life.

Data for the comparison of eight-year-old Canadian and American children on the questionnaire on the origin of night is given in Table 38.

TABLE 38

Comparison of Eight-Year-Old Canadian and American Children on the Questionnaire on the Origin of Night

Subjects	Stages 1A-1B-2	Stage 3A	Stage 3B	Totals
Canadian	39 (26.0)	7 (9.2)	4 (14.8)	50
American	12 (25.0)	11 (8.8)	25 (14.2)	48
Totals	51	18	29	98

df=2, X^2-30.36
$p < .01$

Like their eleven-year-old counterparts, the eight-year-old American children were much freer of precausal responses than were the eight-year-old Canadian children. Thirty-six of the forty-eight eight-year-old American children attained stage 3 as opposed to only eleven of the forty-eight eight-year-old Canadian children. The null hypothesis of no difference is rejected at the .01 level of significance.

A comparable situation occurred for the concept of the movement of clouds as can be seen in Table 39.

TABLE 39

Comparison of Eight-Year-Old Canadian and American Children on the Questionnaire on the Movement of Clouds

Subjects	Stages 1 - 2	Stage 3A	Stage 3B	Totals
Canadian	28 (17.5)	14 (14.5)	5 (15.0)	47
American	7 (17.5)	15 (14.5)	25 (15.0)	47
Totals	35	29	30	94

df=2, X^2=25.97
$p < .01$

Forty of the forty-seven eight-year-old American subjects were able to designate the wind as the prime mover of the clouds whereas only nineteen of the forty-seven eight-year-old Canadian subjects were able to do so. The difference between the observed and expected frequencies was significant at the .01 level. The null hypothesis is rejected for the concept of the movement of clouds.

No significant difference was found when comparing the eight-year-old Canadian and American children on the questionnaire on the floating and sinking of objects. Table 40 presents the data for comparison.

TABLE 40

Comparison of Eight-Year-Old Canadian and American Children on the Questionnaire on the Floating and Sinking of Objects

Subjects	Stages 1 - 2A	Stage 2B	Stages 3A-3B	Totals
Canadian	19 (17.0)	15 (21.0)	16 (12.0)	50
American	15 (17.0)	27 (21.0)	8 (12.0)	50
Totals	34	42	24	100

df=2, X^2=6.57
$p > .01$

There were no stage 1 or stage 3B subjects in either the Canadian or American sample. There were twice as many eight-year-old Canadian children as American children at stage 3A. The reverse is true for stage 2B. However, the difference between the groups is not statistically significant. The null hypothesis is accepted for the concept of the floating and sinking of objects.

Age 6. H_o: There is no difference between six-year old Canadian and American children in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

Table 41 presents the comparison of six-year-old Canadian and American children on the questionnaire on dream.

TABLE 41

Comparison of Six-Year-Old Canadian and American Children on the Questionnaire on Dream

Subjects	Stages 1-2A-2B-2C	Stage 3A	Stage 3B	Totals
Canadian	24 (21.8)	17 (15.1)	3 (7.1)	44
American	22 (24.2)	15 (16.9)	12 (7.9)	49
Totals	46	32	15	93

df=2, $X^2=5.36$
$p > .01$

Although more six-year-old American children gave perfect explanations of the dream, stage 3B, the difference between the six-year-old Canadian and American children at all other stages and substages was minimal. Since the difference was not significant at the .01 level the null hypothesis is accepted for the concept of dream.

The difference between six-year-old Canadian and American children on the questionnaire on life is shown in Table 42.

The difference between the observed and expected frequencies is attributable to chance. Therefore, the null hypothesis is accepted for the concept of life.

The comparison of six-year-old Canadian and American children on the questionnaire on the origin of night is presented in Table 43.

A majority of the six-year-old Canadian and American children resorted to precausal thinking, primarily artificialism and finalism. More of the six-year-old American children attained stage 3. But, the difference in the level of development between the two groups was not significant at the .01 level. The null hypothesis is accepted for the concept of the origin of night.

TABLE 42

Comparison of Six-Year-Old Canadian and American Children on the Questionnaire on Life

Subjects	Stage 1	Stage 2	Stage 3	Totals
Canadian	20 (18.9)	6 (4.3)	11 (13.8)	37
American	24 (25.1)	4 (5.7)	21 (18.2)	49
Totals	44	10	32	86

df=2, $X^2=2.26$
$p > .01$

TABLE 43

Comparison of Six-Year-Old Canadian and American Children on the Questionnaire on the Origin of Night

Subjects	Stages 1A-1B-2	Stage 3A	Stage 3B	Totals
Canadian	41 (37.0)	6 (5.0)	3 (8.0)	50
American	33 (37.0)	4 (5.0)	13 (8.0)	50
Totals	74	10	16	100

df=2, $X^2=7.51$
$p > .01$

There was, however, a significant difference between the six-year-old Canadian and American children on the questionnaire on the movement of clouds. The data for comparison are given in Table 44.

TABLE 44

Comparison of Six-Year-Old Canadian and American Children on the Questionnaire on the Movement of Clouds

Subjects	Stages 1 - 2	Stage 3A	Stage 3B	Totals
Canadian	40 (28.5)	5 (10.5)	1 (7.0)	46
American	17 (28.5)	16 (10.5)	13 (7.0)	46
Totals	57	21	14	92

df=2, X^2=25.33
$p < .01$

Stage 1 indicates a belief in human or divine action as the force behind the movement of clouds. Thirty-eight of the forty-six Canadian subjects gave stage 1 responses. Only nine of the forty-six American six-year-old children explained the movement of clouds by human or divine action. One six-year-old Canadian child and thirteen six-year-old American children indicated that the wind was involved and were free from any precausal thinking, stage 3B.

The difference in the developmental levels of six-year-old Canadian and American children was significant at the .01 level. The null hypothesis is rejected for the concept of the movement of clouds.

It was mentioned before that there was a significant difference in the developmental levels of Canadian and American children on the concept of the movement of clouds for all three age groups. The lower stages assigned to the Canadian children may be partly a function of the extensive use of divine artificialism in response to this questionnaire.

Laurendeau and Pinard (1962) noted that this questionnaire generally gave rise to artificialism and offered as one possible hypothesis "that the child may have a natural affinity for this form of thinking, and that this affinity may be all the closer for being sustained by religious instruction (p. 185)." It should be remembered that the Canadian children attended Catholic schools.

This reasoning may also be applied to explain the lower stages of development attained by the eight and eleven-year-old Canadian children on the questionnaire on the origin of night. As Laurendeau and Pinard (1962) pointed out, the night is "related to the sky, and is thus naturally associated with those beings whom the child is accustomed to locate in heaven (p. 185)."

On the other hand, weather is a prominent topic in the Norwell science curriculum starting in the first grade. By the time the Norwell children reach grade six they are using instruments to predict weather. In other words, there is a gradual but consistent reinforcement of a scientific attitude toward weather phenomena, outer space and the planets, which may help the children to relinquish their precausal responses.

Table 45 presents the comparison of six-year-old Canadian and American children on the questionnaire on the floating and sinking of objects.

TABLE 45

Comparison of Six-Year-Old Canadian and American Children on the Questionnaire on the Floating and Sinking of Objects

Subjects	Stages 1 - 2A	Stage 2B	Stages 3A-3B	Totals
Canadian	29 (25.0)	10 (17.6)	9 (5.4)	48
American	22 (26.0)	26 (18.4)	2 (5.6)	50
Totals	51	36	11	98

df=2, X^2=12.49
$p < .01$

None of the six-year-old children attained stage 3B. Six of the six-year-old Canadian children were in stage 1 as was one of the six-year-old American children. The primary difference was once again at stage 2B which contained half of the American six-year-old children.

The difference between the six-year-old Canadian and American children was statistically significant. The null hypothesis is rejected for the concept of the floating and sinking of objects.

To summarize, significant differences between eleven, eight, and six-year-old Canadian and American children were found for the following concepts:

(a) Eleven-year-old - dream, the origin of night, the movement of clouds, and floating and sinking of objects

(b) Eight-year-old - the origin of night, and the movement of clouds

(c) Six-year-old - the movement of clouds, and the floating and sinking of objects

__Question 5.__ __Grade Differences__

H_o: There is no difference in the level of development attained by children in school grades one, three, and six on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

The data for the American sample on differences according to school grade placement coincide with the data on age differences. Each child within each age group was in the same school grade.

The chi square value computed for each questionnaire is listed in Table 46.

The difference between children in grades one, three, and six is significant at the .01 level. The null hypothesis is rejected for the concept of dream, life, the origin of night, the movement of clouds, and the floating and sinking of objects.

There is no comparable grade level breakdown in the Laurendeau and Pinard (1962) data. Therefore, Canadian and American comparisons cannot be made on this dimension.

TABLE 46

Chi Square Values for Comparison of Children in Grades One, Three, and Six on Each Questionnaire

Name of Questionnaire	Total N	X^2	df	
The Concept of Dream	149	32.90	4	$p < .01$
The Concept of Life	149	22.25	4	$p < .01$
The Origin of Night	148	65.78	4	$p < .01$
The Movement of Clouds	140	26.45	4	$p < .01$
The Floating and Sinking of Objects	150	40.59	4	$p < .01$

Question 6. IQ Differences

H_o: There is no difference between children of varying IQ scores in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

No attempt was made to control for IQ in the selection of this sample. IQ scores were available for 142 of the subjects whose scores ranged from 84 to 155. The median IQ 116 is above average which probably reflects the suburban, middle-class nature of the sample. (See Chapter III).

The observed and expected frequencies, and the chi square value for the comparison of IQ ranges on the questionnaire on dream are presented in Table 47.

The difference between IQ range groups is not statistically significant. But, it should be noted that there is an inverse relationship between IQ range and the proportion of subjects appearing in stages 1 through 2C which are characterized by precausal responses. No subjects with IQ 120 and above were in stage 1. The null hypothesis, however, is accepted for the concept of dream.

Comparison of the various IQ ranges on the questionnaire on life is shown in Table 48.

TABLE 47

Comparison of IQ Ranges on the Questionnaire on Dream

IQ Range	Stages 1-2A-2B-2C	Stages 3A	Stage 3B	Totals
109 and Below	15 (12.0)	5 (9.0)	26 (25.0)	46
110 - 119	13 (11.2)	11 (8.4)	19 (23.4)	43
120 - 129	7 (8.6)	8 (6.5)	18 (17.9)	33
130 and Up	1 (4.2)	3 (3.1)	12 (8.7)	16
Totals	36	27	75	138

df=6, X^2=8.81
p > .01

TABLE 48

Comparison of IQ Ranges on the Questionnaire on Life

IQ Range	Stage 1	Stage 2	Stage 3	Totals
109 and Below	16 (14.3)	9 (8.0)	21 (23.7)	46
110 - 119	14 (13.4)	9 (7.5)	20 (22.1)	43
120 - 129	9 (10.3)	5 (5.7)	19 (17.0)	33
130 and Up	4 (5.0)	1 (2.8)	11 (8.2)	16
Totals	43	24	71	138

df=6, X^2=3.92
p > .01

Forty-four per cent of the subjects attributed life to inanimate objects at least once. The proportion of subjects using animism decreases with increasing IQ range. Nevertheless, the difference between IQ groups is not significant at the .01 level. The null hypothesis is accepted for the concept of life.

Data for the comparison of IQ ranges on the questionnaire on the origin of night are given in Table 49.

TABLE 49

Comparison of IQ Ranges on the Questionnaire on the Origin of Night

IQ Range	Stages 1A-1B-2	Stage 3A	Stage 3B	Totals
109 and Below	15 (14.1)	4 (5.4)	27 (26.5)	46
110 - 119	13 (12.6)	5 (4.8)	23 (23.6)	41
120 and Up	14 (15.3)	7 (5.8)	29 (28.8)	50
Totals	42	16	79	137

df=4, X^2=.80
$p > .01$

Differences between IQ groups were insignificant for this concept. The null hypothesis is accepted for the concept of the origin of night.

Likewise, there was no significant difference between IQ groups found on the questionnaire on the movement of clouds as seen in Table 50.

The null hypothesis is accepted for the concept of the movement of clouds.

Tables 49 and 50 indicate that the least amount of difference between IQ groups is found on the questionnaires on the origin of night and the movement of clouds. Perhaps this reflects the commonality of information and experience derived from the Norwell science curriculum as was suggested before.

TABLE 50

Comparison of IQ Ranges on the Questionnaire on the Movement of Clouds

IQ Range	Stages 1 - 2	Stage 3A	Stage 3B	Totals
109 and Below	10 (8.5)	10 (11.9)	24 (23.5)	44
110 - 119	6 (7.4)	11 (10.3)	21 (20.3)	38
120 - 129	7 (6.0)	10 (8.4)	14 (16.6)	31
130 and Up	2 (3.1)	4 (4.3)	10 (8.6)	16
Totals	25	35	69	129

df=6, X^2=2.43
$p > .01$

Table 51 presents the data for comparison of IQ ranges on the questionnaire on the floating and sinking of objects.

None of the subjects attained stage 3B, and only one subject, in IQ range 120 to 129, was in stage 1. However, the frequency of subjects in stage 2A follows the same trend as that noted for stage 1 on the concepts of dream and life, i.e. a decreasing proportion of subjects as IQ range increases.

The difference between IQ groups is not significant at the .01 level. The null hypothesis is accepted for the concept of the floating and sinking of objects.

At least one trend emerges from these data. A comparison of the highest and lowest IQ ranges presented in Tables 47 through 51 shows that the observed frequency for the highest range does not exceed the expected frequency in any of the stages where precausal thinking is the criterion for designation. On all questionnaires except the floating and sinking of objects, the observed frequency for the lowest range consistently exceeds the expected frequency at those stages where precausal thinking is evidenced.

Moreover, although the lowest range shows mixed results on the stages where causal thinking is required, in the highest range the observed frequency exceeds the expected frequency in all the stages requiring causal thinking for designation.

TABLE 51

Comparison of IQ Ranges on the Questionnaire on the Floating and Sinking of Objects

IQ Range	Stage 1-2A	Stage 2B	Stages 3A-3B	Totals
109 and Below	11 (11.9)	28 (23.8)	7 (10.3)	46
110 - 119	15 (11.1)	17 (22.3)	11 (9.6)	43
120 - 219	8 (8.8)	20 (17.6)	6 (7.6)	34
130 and Up	2 (4.1)	7 (8.3)	7 (3.6)	16
Totals	36	72	31	139

df=6, $X^2=9.97$
$p > .01$

There is no comparable breakdown of data by IQ range in the Laurendeau and Pinard (1962) study. However, they indicated their expectation regarding the comparison of IQ scores and stages of development.

> This is not the place to question the validity of these commonly used measurements. Their analytic and artificial character has been emphasized too often to require further reiteration. As Piaget and Inhelder, for instance, pointed out on several occasions, these tests measure only the end product of intellectual activity, but they completely disregard the internal dynamics of mental operation. One would be ill-advised to draw definite conclusions, on the basis of test results, about the quality of the reasoning process or about the fundamental nature of intellectual maturity. Therefore, the comparison of the mental age of children, as determined by the usual type of psychometric test, with the various stages to which they belong according to a diagnostic examination such as that of Piaget, should not be expected to yield a very high correlation (Laurendeau and Pinard, 1962, pp. 47-48).

The data analyzed in Tables 47 through 51 confirm their expectation. There was no statistically significant difference found between the various IQ groups on the concepts of dream, life, the origin of night, the movement of clouds or the floating and sinking ob objects.

Question 7. Cultural Differences

H_o: There is no difference between Canadian and American children in the level of development attained on each of the following concepts:

(a) Dream
(b) Life
(c) The origin of night
(d) The movement of clouds
(e) The floating and sinking of objects

The comparison of Canadian and American children on the questionnaire on dream is shown in Table 52.

TABLE 52

Comparison of Canadian and American Children on the Questionnaire on Dream

Subjects	Stages 1-2A-2B-2C	Stage 3A	Stage 3B	Totals
Canadian	36 (36.9)	65 (46.7)	43 (60.5)	144
American	39 (38.1)	30 (48.3)	80 (62.5)	149
Totals	75	95	123	293

df-2, X^2=24.07
$p < .01$

The majority of both the Canadian and American children were in stage 3 on the concept of dream. However, more of the American children attained stage 3B which calls for a perfect explanation of dream and no indication of any precausal thinking. More of the Canadian children were at stage 3A in which the children can explain that the dream is interior, personal, and immaterial but they occasionally call upon artificialistic, finalistic or moralistic factors.

The difference between the Canadian and American children is significant at the .01 level. The null hypothesis is rejected for the concept of dream.

There is no significant difference between Canadian and American children on the questionnaire on life. Data for comparison are presented in Table 53.

TABLE 53

Comparison of Canadian and American Children
on the Questionnaire on Life

Subjects	Stage 1	Stage 2	Stage 3	Totals
Canadian	47 (44.2)	25 (24.0)	60 (63.9)	132
American	47 (50.0)	26 (27.1)	76 (72.1)	149
Totals	94	51	136	281

df=2, X^2=.88
$p > .01$

Although a greater proportion of American children were free of animistic thinking, stage 3, the difference between the observed and expected frequency is attributable to chance. No doubt this comparison is affected by the drop in frequency at stage 3 which was noted for the eleven-year-old American children.

Since the difference between the Canadian and American children is not significant, the null hypothesis is accepted for the concept of life.

Data for the comparison of Canadian and American children on the questionnaire on the origin of night is given in Table 54.

Only thirty-seven per cent of the Canadian children attained stage 3 which requires physical explanations for the origin of night. Most of the Canadian children still resorted to artificialism and finalism in their responses. Sixty-nine per cent of the American children were free of artificialism and fifty-eight per cent of the American children were totally free of all precausal thinking.

The difference between the Canadian and American children is significant at the .01 level. The null hypothesis is rejected for the concept of the origin of night.

TABLE 54

Comparison of Canadian and American Children on the Questionnaire on the Origin of Night

Subjects	Stages 1A-1B	Stage 2	Stage 3A	Stage 3B	Totals
Canadian	37 (34.7)	57 (35.7)	23 (19.6)	33 (59.9)	150
American	32 (34.3)	14 (35.3)	16 (19.4)	86 (59.1)	148
Totals	69	71	39	119	298

df=3, X^2=51.26
p$<$ .01

There is an even greater difference between the Canadian and American children on the questionnaire on the movement of clouds in Table 55.

TABLE 55

Comparison of Canadian and American Children on the Questionnaire on the Movement of Clouds

Subjects	Stage 1	Stage 2	Stage 3A	Stage 3B	Totals
Canadian	67 (39.4)	15 (16.2)	32 (34.9)	29 (52.6)	143
American	11 (38.6)	17 (15.8)	37 (34.1)	75 (51.4)	140
Totals	78	32	69	104	283

df=3, X^2=61.01
p.$<$.01

While the frequencies are somewhat comparable at stages 2 and 3A, the frequencies at the extreme stages are clearly reversed. Fifty-seven per cent of the Canadian children attributed the movement of clouds to human or divine action, stage 1, while fifty-four per cent of the American children gave correct explanations freed from any precausal thinking, stage 3B. Since the difference between the Canadian and American children is significant, the null hypothesis is rejected for the concept of the movement of clouds.

Table 56 presents the data for comparison of Canadian and American children on the questionnaire on the floating and sinking of objects.

TABLE 56

Comparison of Canadian and American Children on the Questionnaire on the Floating and Sinking of Objects

Subjects	Stages 1 - 2A	Stage 2B	Stages 3A-3B	Totals
Canadian	56 (47.2)	33 (54.1)	59 (46.7)	148
American	39 (47.8)	76 (54.9)	35 (47.3)	150
Totals	95	109	94	298

df=2, χ^2=26.12
$p < .01$

None of the children in either sample attained stage 3B which requires that the child formulate the exact principle of the floating and sinking of objects. Seven of the Canadian children were in stage 1 where explanations do not go beyond the precausal level. Only one American child was in stage 1. Forty-nine of the Canadian children and thirty-eight of the American children were in stage 2A. However, more Canadian than American children appear at stage 3A and about half of the American sample were designated stage 2B.

The difference between the Canadian and American samples is significant at the .01 level. So, the null hypothesis is rejected for the concept of the floating and sinking of objects.

Significant differences between the Canadian and American children were found on four of the five questionnaires. The diff-ences on the concept of dream, the origin of night, and the movement of clouds favor the American sample. That is, on these three questionnaires, fewer American children offered precausal responses, and, more of the American children explained the phenomena in terms of the logical, causal criteria required for stage 3.

The American children also offered fewer precausal responses to the questionnaire on the floating and sinking of objects. However, this is the only questionnaire, in which a significant difference is found, where the Canadian children seemed to offer more of the logical reasons for the phenomenon.

The reversal of the direction of difference on the concept of the floating and sinking of objects can probably be attributed to an overly rigorous interpretation of the description of stages 2B and 3A. It should be noted that in all of the tables dealing with the floating and sinking of objects an unusually large number of American subjects appear in stage 2B. It was previously suggested that some of these subjects probably belong in stage 3A.

The criteria outlined by Laurendeau and Pinard (1962) indicate that the differences between stage 2B and 3A responses are minimal. To clarify the difference, the evaluators of the American sample decided not to designate a protocol as stage 3A unless the responses indicated both logical reasoning and made reference to the presence of air in the objects. Without the reference to air in the objects the protocol was designated stage 2B. (See Appendix B).

Despite the problem with this one questionnaire, it is clear that the intra-sample differences are the same, i.e., the responses of both the Canadian and American samples to the five questionnaires reveal a decrease in precausal modes of thinking with an increase in chronological age and only an occasional variation between the sexes. The course of development, then, is essentially the same. But, the inter-sample differences would seem to indicate a difference in the rate of development which may be partly linked to environmental factors.

It may be, for instance, that children in suburban Norwell have had more experience with natural phenomena than the urban children in Montreal. It is also possible that the American public schools in 1969 stress the adoption of scientific attitudes more than did the Canadian Catholic schools in the late 1950's. Such an attitude would be strengthened by awareness of the American space program and particularly the lunar landing which was given so much television time.

The lack of difference between the Canadian and American samples on the questionnaire on life may be a special case. On the other four questionnaires, in order to reach stage 3, the child had to keep in mind only one or two facts at the most. For example, on the questionnaire on dream he had to be aware of "it's in my mind"; the origin of night he had to connect with the disappearance of the sun; the movement of clouds he had to attribute to the wind; and the floating and sinking of objects he had to relate to density and volume. However, in order to distinguish if an object had life or was inanimate, he had to apply four criteria every time since living things are distinguished by growth, metabolism, reproduction, and adaptation to the environment.

When an item calls for remembering several dimensions simultaneously, environmental factors may not have as much effect as has been suggested otherwise.

Question 8. Effect of the Concepts Tested

> H_o: The level of development attained on the Laurendeau and Pinard questionnaires does not vary with the concept being tested.

The Friedman two-way analysis of variance by ranks yielded an Xr^2 value of 36.61. Since the critical chi square value at the .01 level of significance is 13.28 for df = 4, the null hypothesis is rejected. Therefore, one may conclude that the stage of development attained on each of the questionnaires is dependent upon the concept being tested.

This finding agrees with the Laurendeau and Pinard (1962) study and was expected. The questionnaires were designed to elicit specific forms of precausal thinking each of which characteristically disappears at a different age and is used to determine the stage of development.

> The precausal beliefs related to the five problems of the experiment are not altogether contemporaneous. Realism disappears at approximately six and a half years of age, artificialism around nine, animism and dynamism around ten. Since finalism is not the subject of a specific questionnaire, it is not possible to pronounce on its evolution (Laurendeau and Pinard, 1962, p. 248).

Considering this expected discrepancy, some of the American children were amazingly consistent. Sixteen of the 150 subjects were in stage 3 on all five questionnaires. Two of these subjects were six-years old, five were eight-years old, and nine were eleven-years old. Eight more subjects were in stage 3 on all but the concept of the floating and sinking of objects where they were in stage 2B. The possibility that they might belong in stage 3A has already been discussed. Of this group, two were six-years old, five were eight-years old, and one was eleven-years old.

Only one eight-year-old subject was in stage 2 on all of the questionnaires and none was consistently in stage 1.

Summary

In this chapter the American data, obtained from the administration of the Laurendeau and Pinard (1962) questionnaires, were analyzed for (a) evidence of precausal thinking, (b) sex differences, (c) age differences, (d) school grade differences, (e) IQ differences, and (f) the effect of the concepts being tested.

The American data were compared with the Canadian data to determine the effect of religious instruction, and to determine the differences on the dimensions of sex, age, and culture.

Chapter V

Summary, Conclusions, Implications and Recommendations

The purpose of this study was to assess the developmental stages of causal thinking in a sample of American public-school children and to compare the results with the Laurendeau and Pinard (1962) findings obtained on a sample of French-speaking, Canadian Catholic-school children. It was also aimed at the verification of the existence of precausal thinking and of the characteristic stages in the development of causal thinking as predicated by Piaget (1926, 1927).

The sample of 75 boys and 75 girls, ages 6, 8, and 11 was enrolled in school grades 1, 3, and 6 in a suburban Massachusetts town.

The standardized Laurendeau and Pinard (1962) questionnaires were administered to elicit responses concerning the concepts of dream, life, the origin of night, the movement of clouds, and the floating and sinking of objects. The responses were evaluated for instances of precausal thinking, i.e., realism, animism, artificialism, finalism, and dynamism. The subjects were then assigned to developmental stages for each concept by three independent judges employing the Laurendeau and Pinard (1962) scales. Thus, the data were reported in terms of the frequency of usage of the various forms of precausal thinking and the frequency of subjects appearing at each stage of development for each concept.

Chi square analysis was employed to determine if the stages of development for the American subjects were influenced by sex, age, school grade, or IQ. The Friedman two-way analysis of variance by ranks was used to determine whether the stage of development was influenced by the concept being tested. The chi square technique was also applied to the comparison of the developmental stages of the Canadian and American samples, differentiated by sex and age. All statistical tests were made at the .01 level of significance.

Conclusions

The results would appear to warrant the following conclusions:

1. Animism, artificialism, and finalism are the most frequently used modes of precausal thinking.

2. Younger children tend to use a greater number of precausal modes of thinking than do older children.

3. The use of precausal modes of thinking decreases with increasing age.

4. Boys and girls use the various modes of precausal thinking with about equal frequency.

5. Children who attend all-day religious schools do not offer more animistic explanations than children who attend public schools. However, formal religious training may affect the amount of divine artificialism offered in explanations of physical causality.

6. There are no significant differences in the developmental levels that boys and girls attained for the concepts of dream, life, the origin of night, or the movement of clouds.

7. There is a significant difference in the developmental levels that boys and girls attained on the concept of the floating and sinking of objects.

8. There is a significant difference between Canadian and American boys and girls in the level of development attained on the concepts of dream, the origin of night, the movement of clouds, and the floating and sinking of objects.

9. There is no significant difference between Canadian and American boys and girls in the level of development attained on the concept of life.

10. There is a significant difference in the level of development attained by 6, 8, and 11-year-old children on each of the concepts tested.

11. There is a significant difference between 11-year-old Canadian and American children in the level of development attained on the concepts of dream, the origin of night, the movement of clouds, and the floating and sinking of objects.

12. There is no significant difference between 11-year-old Canadian and American children in the level of development attained on the concept of life.

13. There is a significant difference between 8-year-old Canadian and American children in the level of development attained on the concepts of the origin of night, and the movement of clouds.

14. There is no significant difference between 8-year-old Canadian and American children in the level of development attained on the concepts of dream, life, and the floating and sinking of objects.

15. There is a significant difference between 6-year-old Canadian and American children in the level of development attained on the concepts of the movement of clouds, and the floating and sinking of objects.

16. There is no significant difference between 6-year-old Canadian and American children in the level of development attained on the concepts of dream, life, and the origin of night.

17. There is a significant difference in the level of development attained by children in school grades 1, 3, and 6.

18. There is no significant difference between children of varying IQ scores in the level of development attained on each of the concepts tested.

19. There are significant differences between Canadian and American children in the level of development attained on the concepts of dream, the origin of night, the movement of clouds, and the floating and sinking of objects, but not on the concept of life. The differences appear to favor the older American children which suggests that suburban, American public-school children acquire causal thinking earlier than do urban, Canadian Catholic-school children.

20. The various concepts have a differential effect on the level of development attained on each of the questionnaires.

Implications and Recommendations

The results of this study support the underlying Piagetian theory. The development of causal thinking appears to proceed in age-related stages during which the child progressively relinquishes his egocentric view of reality and causality.

The child's egocentrism is manifested in the use of precausal forms of thinking which pervade his responses to questions concerning the causes of physical phenomena. This study confirmed the existence and pervasiveness of the various forms of precausal thinking. Furthermore, the relationship of egocentrism to age was indicated by the decrease in usage of precausal modes of thinking with increasing chronological age.

The Piagetian theory of the development of causal thinking should be of interest to the curriculum builder. Many of the concepts taught in the science and social studies curricula assume that the child has the ability to grasp the cause-effect relationship of things and events in his environment. Each new concept to be introduced should be analyzed in terms of the logical structures which are necessary for the assimilation of the new material.

By systematic replication Laurendeau and Pinard (1962) have confirmed Piaget's findings and have developed a standardized method of determing the child's level of development of causal thinking. The results of this study support the Laurendeau and Pinard (1962) findings with regard to the age-related stages of development and the manifestation of precausal forms of thinking. These aspects of the development of causal thinking appear to be constant across cultures although the rate of development varies.

It was shown that the course of development of causal thinking for the Canadian and American samples is essentially the same. However, it is the differences between the samples which must now be examined for educational implications and recommendations for further study.

In Chapter I it was noted that the norms developed from the Canadian sample are to be incorporated into a new scale of intellectual development. Since there are significant differences between the Canadian and American subjects (at least for ages 6, 8, and 11) it would seem unwise to use a developmental scale where the norms are based on the Canadian sample to test American children.

However, since the course of development is essentially the same the Laurendeau and Pinard (1962) questionnaires should be used to develop a set of American norms. This study, then, should be extended to the age groups from four to twelve, not presently included, in order to be able to compute ages of accession to each stage of development for each concept and thereby develop applicable norms.

Greater differences occurred between the older Canadian and American subjects. A more inclusive study may reveal the specific points at which the divergence began to be significant.

The question remains, of course, as to why the differences occurred in the first place. In a personal correspondence dated March 27, 1970, Professor Pinard suggested that the difference in favor of the American subjects "might be partly attributable . . . to the fact that your sample was perhaps somewhat more intellectually advanced than our average sample . . ." Since the median IQ of the American sample was 116, the point may be well taken. Future researchers should perhaps attempt to select a more normal population for study.

However, it might also be advantageous to explore more carefully the role of experience and environmental factors in the development of causal thinking. The advanced rate of development of the American children may be due to the introduction of experiences through play or planned curriculum at propitious moments. More research is needed to decide whether the daily experiences of suburban children with natural, physical phenomena really do facilitate the development of causal thinking, and, if so, whether a series of planned classroom activities could produce the same results with other groups of children.

The role of experience and environmental factors in the development of causal thinking might also be investigated by replicating this study with (a) a sample of inner city children whose experiences and environments differ from that of suburban children, and (b) a sample of physically handicapped children who are restricted in the direct experiencing and manipulation of their environment.

It has already been suggested that a gradual but consistent reinforcement of a scientific attitude toward physical phenomena may have helped the American children to relinquish their precausal responses. However, the role of the science curriculum in the development of causal thinking should be explored further. Perhaps one way to do this would be to assess the developmental levels of matched groups of children using as independent variables such things as course content, methodology, and the timing of formal instruction.

The emphasis on timing and the propitious moment for the introduction of new material is consistent with Piagetian theory. Until the child has developed the logical structures necessary to assimilate new information he is apt to distort the input. The drop in the frequency of eleven-year-old American children at stage 3 on the concept of life may be a case in point. It was hypothesized that the direct teaching of specific criteria for judgment of "aliveness" temporarily interfered with the intuitive model of some children. In other words, it was not the propitious moment for the introduction of new criteria since the children had not developed the logical structure to assimilate the material and accommodate to it. The effect of the timing of experiences which may facilitate causal thinking requires further research.

Another suggested area for investigation is the effect of religious instruction on the development of causal thinking. The significant difference between the Canadian and American samples in the frequency of usage of divine artificialism was attributed to the influence of religious instruction. It may be that formal religious instruction attentuates other forms of precausal thinking as well. This study should be replicated with a matched sample of American Catholic-school children to test (a) whether the differences between the Canadian and American groups would then be reduced due to the influence of religious instruction, and (b) whether there would be a significant difference between American Catholic and public-school children.

There are also some general implications for teaching which can be derived from this study. For example, a careful perusal of the protocols reveals that elementary school teachers should be very cautious about accepting the correct vocabulary as an indication of real understanding of a concept. In many instances, the initial responses to the Laurendeau and Pinard (1962) questionnaires were technically correct. But, continued probing into the limits of the child's understanding showed a disparity between the child's use of labels and his understanding of a concept. The initially correct response was often followed by precausal explanations.

The clinical interview technique seems to be a very appropriate means of probing the child's understanding. It allows the teacher to go beyond the one-word or simple phrase answers which do not reveal the underlying logical structures of the child's thought. Certainly teachers should be as aware of the modes of thinking which young children employ as they are of the content of the child's thought. Therefore, it might be useful for teachers to become more adept at applying the clinical interview technique to the classroom situation.

It should also be noted that the child's ability to grasp the cause-effect relationship varies with the concept in question. Causal thinking does not follow the all-or-none rule. It cannot be assumed, then, that a particular child is at a given stage of development in causal thinking. He may be concurrently at several stages. The concept of individual differences must also include intra-individual differences even within a single academic subject.

Finally, since causal thinking is applicable to all areas of a child's life the relationship between the development of physical causality, psychological causality, and social causality should also be investigated. As far as can be determined there is no empirical evidence yet to determine whether the development of physical causality precedes the development of psychological and social causality or whether they develop in concurrent and analogous stages.

An understanding of the nature of the child's thinking is essential to the curriculum builder and to the teacher. If, as Piaget claims, it is the nature of causal thinking to develop in characteristic stages, then, the curriculum builder and teacher must be aware of these stages if he is to plan and execute academic sequences which are relevant to the child's level of development. The results of this study definitely add to the support of that claim.

Although the effect of causal thinking cuts across subject lines, perhaps it is most easily recognized in the learning of science. For it is in investigating the "hows" and "whys" of the physical environment that the child develops an internal representation of the world in which he lives. The possibility of an educator's furtherance of this development should be enhanced by knowledge of the way the child actually views the world and its functions.

APPENDIX A

THE LAURENDEAU AND PINARD QUESTIONNAIRES

EXPERIMENTAL QUESTIONNAIRES

THE CONCEPT OF DREAM

Instructions

Ask the child each one of the following questions, trying always to make sure he understands it well. When necessary, change the wording of the questions, using terms more familiar to the child, but be very careful never to suggest more than is included in the instructions. Record all answers verbatim.

A. General questions

"Do you know what a dream is? Do you dream sometime at night?"

B. Specific questions

1. Origin of dreams

"Tell me, where does a dream come from?"
"Where are dreams made, where do they come from?"
"Do they come from inside of you, or from outside of you?"
"Who makes the dream come?"
"Is it you, or someone else? Who?"

2. Location of dreams

"While you are dreaming, where is your dream? Where does it go on, in what place is it?"
"Is it inside of you, or in your room?"

(a) If the dream is internal (in the head, in the thought, etc.), say:
"If we could open your head while you are dreaming, if we could look into your head, could we see your dream?"
"Why do you say that we could (not) see your dream?"
"Then, where is it, in your head, your dream?"

(b) If the dream is external (in the room, on the wall, under the bed, close to the eyes, etc.), say:
"Is it in your room (on the wall, etc.) for real, or is it only as if it were there? Or does it only seem to be there?'

"While you are dreaming, are your eyes closed or open?"
"Then, where is the dream?"
"When you dream that you are playing in the street, where is your dream? In the street, or in your room?"

(c) In both cases, go on with:
"Is there something in front of you while you are dreaming?"
"Your mother, when she is in your room, can she also see your dream?"
"And I, if I were in your room, could I see your dream?"
"Why do you say that I could (not) see your dream?"

3. Organ of dreams

"Then, tell me, what do we dream with? Is it with our hands? With what, then?"

4. Cause of dreams

"What did you dream about, the last time?"
"Why did you dream about that?"

If the child says he did not dream, ask him:
"Let's make believe you dreamed you had fallen and hurt yourself. . . . Why did you dream about that?"
"Then, do you know why we dream? Why there are dreams?"

5. Substance of dreams

"What is a dream made of? Is it made of paper? Then, what is it made of?"
"Can we touch our dreams? . . . Why do you say that we can (cannot) touch our dreams?"
"Is a dream a thought, or is it a thing?"

6. Reality of dreams

"During the night, when you dream you are playing, are you playing for real?"
"Is it the same as when you are playing during the day?"
"Then, are our dreams true?"

THE CONCEPT OF LIFE

Instructions

Ask the child each one of the following questions, trying always to make sure he understands it well. When necessary, change the wording of the questions, using terms more familiar to the child, but be very careful never to suggest more than is included in the instructions. Record all answers verbatim.

A. General questions

"Do you know what it is to be alive, to be living? What does it mean?"
"Give me the name of some things which are alive?"

B. Specific questions

1. Individual objects

(a) "Is a mountain alive?"
"Why do you say it is (not) alive?"

(b) Continue with the following objects, asking each time the same question as in (a):

(2) the sun
(3) the table
(4) an automobile
(5) a cat
(6) a cloud
(7) a lamp
(8) a watch
(9) a bird
(10) a bell
(11) the wind
(12) an airplane
(13) a fly
(14) the fire
(15) a flower
(16) the rain
(17) a tree
(18) a snake
(19) a bicycle
(20) a fish
(21) a pencil

2. Comparisons

(a) "Take the rain and the fire: is one of them more alive than the other?"
"Why do you say that it is the . . . which is more alive?"

(b) Continue with the following comparisons, asking each time the same questions as in (a):

(2) " . . . the wind or a bicycle?"
(3) " . . . a fly or a cloud?"
(4) " . . . a child or a cat?"
(5) " . . . a flower or an airplane?"

THE ORIGIN OF NIGHT

Instructions

Ask the child each one of the following questions, trying always to make sure he understands it well. When necessary, change the wording of the questions, using terms more familiar to the child, but be very careful never to suggest more than is included in the instructions. Record all answers verbatim.

A. General questions

"Do you know what the night is? Tell me, what is night?"
"Why is it dark at night?"
"Where does the dark come from at night? What makes it night?"

B. Alternate sections

In answer to the above questions, the child usually regards either one of three different phenomena as the origin of night: (1) sleep; (2) clouds (or black "air"); (3) the disappearance of the sun. According to the child's answer, proceed with the appropriate series of prepared questions listed in one of the three sections below.

It may happen, however, that the child's initial answers do not fall exactly into one of the three categories suggested above. When this occurs, try to clarify the first response by using the child's answer in a question until his explanations indicate which of the three phenomena he considers as being the origin of night. For instance, ask: "How does . . . (use the child's initial answers) . . . go about making the night?" Whenever this is necessary, record each one of the additional questions and each one of the child's answers verbatim. Should the child change the category of his answer during the questioning, ask all the questions of the section corresponding to the new category.

Section 1: sleep

"Do you sleep, sometimes, during the day? Can we sleep during the day?"
"Is it dark when we sleep in the daytime?"
"Then, why is it dark at night?"
"Why is it dark only at night?"
"Are there times when it is night and you do not sleep?"
"When you stay up late at night, is it dark outside?"
"Then, how is it that it is dark when you do not sleep?"

Section 2: clouds (or black "air")

"Where do these clouds come from? What makes these clouds?"
"How does . . . (the child's answer) . . . make the clouds?"
"What does he make them with?"
"Why do these clouds come only at night?"

"The clouds at night, are they white or black?"
"Can white clouds make it night?"
"Why do you say that . . . (the child's answer) . . . ?"
"During the day, are there clouds sometimes?"
"Then why, when there are clouds in the daytime, is it not dark like at night?"
"At night, is it black clouds which take the place of white ones, or white clouds which turn black?"
"Where do the white clouds go at night?"

Section 3: disappearance of the sun

"Can you explain how it becomes dark when the sun is gone?"
"Where does the sun go at night?"
"Why does the sky become dark at night?"
"Is the sun always there during the day? When it rains, do we see the sun?"
"Then, why is it not dark like at night, when it rains?"
"Then, why is it dark only at night?"

C. Concluding questions (to be asked of all children)

Ask all subjects, whatever their answers to the preceding questions may have been:

"Can we make the night in this room? If I pull the blinds down, is it going to be dark?"
"Then, how is it? Where does the dark in the room come from?"
"And the dark outside, what is it?"
"When it is light, why is it light?"
"What makes it day?"

THE MOVEMENT OF CLOUDS

Instructions

Ask the child each one of the following questions, trying always to make sure he understands it well. When necessary, change the wording of the questions, using terms more familiar to the child, but be very careful never to suggest more than is included in the instructions. Record all answers verbatim.

A. General questions

"Have you ever seen clouds moving forward?"
"What makes them move?"

B. Alternate sections

In answer to the above questions, the child usually names either one of three different categories of causes behind the movement of clouds: (1) man (makes the clouds move as he walks); (2) God, celestial bodies, any meteorological phenomenon, even the clouds themselves, or man (without any reference to walking), etc.; (3) the wind. According to the child's answer, proceed with the appropriate series of prepared questions listed in one of the three sections below.

It may happen, however, that the child's initial answers do not fall exactly into one of the three categories suggested above. When tthis occurs, try to clarify the first response by using the child's answer in a question until his explanations indicate to which of the three categories given above he ascribes the cause of the movement of clouds. For instance, ask: "How does . . . (repeat the child's answer) . . . go about making the clouds move?" Whenever this is necessary, record each one of the additional questions and each one of the child's answers verbatim. Should the child change the category of his answer during the questioning, ask all the questions of the section corresponding to the new category.

Section 1: man (as he walks)

"Can you make them move?"
"When I walk and you stand still, do the clouds move?"
"And at night, when everybody is asleep, do the clouds move?"
  If yes:
    "But you just told me it's people who make the clouds move when they are walking?"
  If no:
    "Why don't the clouds move?"
"Have you ever seen if the clouds move when you stand still?"
"Do they move when you stand still?"
  If yes:
    "Then, what makes them move?"
  If no:
    "Why don't they move?"
"Why do the clouds sometimes move fast and sometimes move slowly?"
"Can the clouds go where they want? . . . Why can (can't) they go where they want?"
"Do the clouds know they are moving? Why do (don't) they know they are moving?"
"Do the clouds know it's we who make them move, when we are walking?"

"Can the wind make the clouds move?"

If yes:

"How does the wind go about making the clouds move?"

"Where does the wind come from?"

(then continue with section 3)

If no:

"Why can't the wind make the clouds move?"

Section 2: God, celestial bodies, etc.

"How does it (he,she, they) go about making the clouds move?"

(or, "How do the clouds go about moving by themselves, all alone?")

"Do the clouds move by themselves alone, or is there something to make the move?"

"Do the clouds know they are moving?"

"Do they know it's . . . (the child's answer) . . . who make(s) them move?"

"Why do you say that they (do not) know it?"

"And . . . (the child's answer) . . . does it (he, she, they) know it makes the clouds move?"

"Can the clouds go where they want? . . . Why can (can't) they go where they want?"

"But why do the clouds move?"

"Why do the clouds move fast sometimes, and sometimes move slowly?"

"Can the wind make the clouds move?"

If yes:

"How does the wind go about making the clouds move?"

"Where does the wind come from?"

(then continue with section 3)

If no:

"Why can't the wind make the clouds move?"

Section 3: the wind

"Where does the wind come from?"

"Can the clouds make wind?"

"By moving, can the clouds make wind?"

"When there is no wind, can the clouds move by themselves?"

"Where does the wind come from?"

"How is the wind made?"

"Give me the name of some thing which can make wind?"

"Why do the clouds move fast sometimes, and sometimes move slowly?"

"Can the clouds go where they want? . . . Why do you say they can (can't) go where they want?"

"Do the clouds know they are moving?"

"Do the clouds know it's the wind that makes them move?"

"And does the wind know it makes the clouds move?"

THE FLOATING AND SINKING OF OBJECTS

Material

1 rectangular plastic receptacle (3" x 3" x 4½");
2 cylindrical plastic receptacles (1 3/4" x 1" diam.);
1 wood cylinder to fit exactly into the cylindrical receptacle;
1 pair of tongs (to place the objects in, and remove from, the water);
1 plasticine ball about 1½" in diameter;
6 objects: a miniature boat (2" x 3/4" x 3/4"), a large glass marble (1" diam.), a small glass marble (½" diam.), a wooden bead (1" diam.), a nail (2"), a wooden peg (2" x 3/16" diam.).

Instructions

Fill the large receptacle about three quarters full of water and place it on the table in front of the child.

Problem 1 (floating and sinking of various objects)

Present the following items successively. The child can feel the weight of each item if he so desires. It is even advisable to let him place the objects in the water himself in order to increase his interest.

(a) First, show the miniature boat and ask:

"If I put this small boat in the water, will it remain on the water or will it sink, go to the bottom?"
"Explain to me, why you think it will . . . (the child's answer)?"

Place the boat in the water and, if the child has predicted it would sink, ask:
"Why does it remain on the water, why doesn't it go to the bottom?"

(b) Show the large marble and ask:

"And this marble, will it go to the bottom, or will it remain on the water?"
"Why do you think it will . . . (the child's answer)?"
Drop the marble in the water, and if the child has predicted it would float, ask:
"Why does it go to the bottom, do you think?"

(c) Show the wooden bead and proceed exactly as in (a).
(d) Show the small marble and proceed exactly as in (b).

(e) Show the nail and proceed exactly as in (b).

(f) Show the wooden peg and proceed exactly as in (a).

In all the preceding problems, as well as in the following, if the child just explains the floating or sinking by the substance the object is made of ("Because it's made of wood, because it's made of glass, of steel," etc.), ask him each time to explain further, saying for instance:
"Why does it stay on the water when it's made of wood?"
"Why does it sink, why does it go to the bottom when it's made of steel (iron), glass, etc.?"

Problem 2 (floating and sinking of similar objects)

(a) Nail and wooden peg.

Take all the objects, except the nail and the wooden peg out of the water and then say:
"You see, there's only the small nail and the stick left.
"Then, tell me how it happens, how is it that the small nail went to the bottom and that the stick remains on top of the water?"

(b) Small marble and wooden bead.

Take the nail and the wooden peg out. Take the small marble and the wooden bead and put them (or have the child put them) in the receptacle, saying:
"And now, you see? The small marble went to the bottom and the wooden bead remained on top of the water. How's that? Explain it to me."

Problem 3 (sinking of a small marble in comparison with the floating of a large boat).

Retrieve the marble and the bead, and ask simply:
"Have you ever seen a large boat? Then, tell me, why do large boats remain on the water?"

If the explanation is based on the movement of the boats (they move, they have a motor, sails, oars, etc.), ask again, before going on with the questionnaire:
"If the large boats didn't move, if they were standing still (if they didn't have a motor, oars, etc.), would they go to the bottom?"
"Explain to me, why they . . . (the child's answer)?"

"Which is heavier: a large boat or a marble like this (hand the child the small marble)?"
"Does a marble go to the bottom?"
"And does a large boat stay on top of the water?"
"Then, why does a large boat stay on top of the water, and a marble goes to the bottom?"
"Which is heavier if you take them in your hands, the large boat or the marble?"
"Then, why does the boat remain on the water?"
"In a large lake, would the marble still go to the bottom?"
"Explain to me, why you say that . . . (the child's answer)?"

Problem 4 (difference in weight between water and wood)

Take both cylindrical receptacles. Fill the first one with water (from the square receptacle) and put the wood cylinder into the other one. Show the two full receptacles but do not let the child take them into his hands to feel the weight. Then say: "You see, it's the same quantity (the same thing) of wood and water. The two small glasses are full so it's the same quantity in both. Which is heavier, do you think, this one or that one, the one filled with water or the one filled with wood?"
"Why do you think it is the one filled with . . . (the child's answer)?"

Problem 5 (floating and sinking of plasticine)

Remove all objects from the square receptacle. Show the child the plasticine ball (he may weigh it if he wishes) and ask: "If I put this in the water, will it remain on top of the water or will it go to the bottom?"
"Explain to me, why do you think that it will . . . (the child's answer)?"

Put the ball in the water. If the child's prediction was correct, make him realize he was right. If his prediction was wrong, ask him to explain why the plasticine ball went down to the bottom.

Then take the ball out, give it to the child, and say:

"Try to fix it so that it will remain on top of the water, so that it will float. Make something with the plasticine so that it will remain on top of the water. Can you do something to it so that it will remain on top of the water, so that it will not go down to the bottom?
Then, try: what do you have to do, do you think, to make it float?"

Let the child work and record exactly everything he does (whether he tries to make smaller and smaller balls, whether on the contrary he tries to make the ball hollow, to form some kind of boat, etc.). When the child wants to test his answer by putting his construction in the water, let him do so but make a note of it. If the child then realizes he did not succeed in making it float and wants to try again, let him keep on trying with as many trials as he wishes during a maximum five-minute time period. However, make detailed notes of each one of these trials.
During these various attempts, try to make the child give, if he does not do so spontaneously, the reasons for the different transformations of the plasticine ball.

If the child does not succeed in making the plasticine float:

Gather all the plasticine and model it in the shape of a crucible (about 2" in diameter and 2" deep).
Set the crucible down on the water and question the child in the following way:
"You see, it floats now. Why does it float, do you think, when it's made like that? What makes it float, now?"
"Why does a ball go down to the bottom, and this now remains on top of the water?"

If the child succeeds by himself in making the plasticine float:
Simply ask him to explain the phenomenon, saying:
"Explain to me, why it floats when it is like this. What makes it float?"
"Why has the ball gone to the bottom a moment ago and this, now, remains on top of the water?"

Record all the child's answers verbatim.

APPENDIX B

ABRIDGED CRITERIA FOR EVALUATION OF THE LAURENDEAU AND PINARD QUESTIONNAIRES

CRITERIA FOR EVALUATION OF THE CONCEPT OF DREAM

Stage 0 - Incomprehension or Refusal

a) Refuses to answer the questions.
b) Doesn't show any sign of real understanding.
c) Merely accepts any suggestion as the interview goes on or breaks away from the examination for some other interest.

Stage 1 - Integral Realism

a) Express a complete belief in the reality of dreams.
b) Origin of the phenomenon is still often rather vague but it is always external to the child. Usually coupled with an artificialistic cause: God, the sandman, etc., cause the dream.
c) The events that occur in the dream have an origin external to the dreamer and also take place in front of him.
d) Usually agree that others in the room can see the dream.
e) Some children recognize that the dream is essentially an illusion yet continue to consider it an objective phenomenon, that is external to the dreamer.

Stage 2 - Mitigated Realism

Protocols classified as belonging in Stage 2 show a great variety and represent about all the degrees of transition between the two opposite attitudes: absolute realism and integral subjectivism.

Substage 2A - Almost totally identical with the realistic answers of Stage 1. These subjects, however, make an effort, still very faltering and awkward, to interiorize the dream when questioned on its origin, on its course, or any other aspect.

Substage 2B - Steadier balance between realism and subjectivism. Confusion of internal and external elements - The internal and subjective element is inevitably supplemented by some contribution from the outside. In short, as soon as subjective elements play a definite role in the child's explanation, and as long as this explanation still indicates a confusion between the interiority and the exteriority of the dream, the protocol is classified in substage 2B.

Substage 2C - The only trace of realism remaining in all children classified in 2C consists in granting a certain materiality to the dream. The dream is interior: it is even invisible under normal conditions, but it could be touched or seen if head of dreamer could be opened without waking him up. The child may even deny the possibility of seeing the dream inside the head, but the reason he gives is not sufficient to prove that he believes that the dream is not material.

Stage 3 - Integral Subjectivism

During the third stage, all traces of realism disappear, The origin of the dream and its course are henceforth interiorized.

Substage 3A - Although they say that the dream is interior, personal, and immaterial, these children will occasionally call upon artificialistic, finalistic or moralistic factors.

Substage 3B - Child gives a perfect explanation of the dream, and the questioning no longer brings out any indication of precausal thinking.

CRITERIA FOR THE EVALUATION OF THE CONCEPT OF LIFE

Stage 0 - Incomprehension or Refusal

a) Refuse to answer.
b) Obviously do not understand the meaning of the question.
c) Answer at random without ever giving any valid reason for their affirmations or denials.
d) Children of this stage do not seem to attach any particular importance to their answers; they are led by their fancy, and their explanations most often arise from pure description.

Stage 1 - Animistic Thinking Based Upon Usefulness, Anthropomorphism, or Movement

The stage 1 subjects commit errors of the animistic type by attributing life to one or many inanimate objects. These errors derive from the fact that the criteria they use are inadequate (usefulness), imperfect (anthropomorphism), or simply incomplete (movement). More frequently, a combination of two, sometimes even of three, of these criteria can be observed..

a) The child's thinking is always consistent. He never resorts to the same reason to attribute or to refuse life.
b) Number of errors will vary considerably.
c) Denial of life to animate objects occurs quite frequently.

Stage 2 - Autonomous Movement With Some Residual Animistic Thinking

These subjects distinguish between mobile objects which receive their impetus from an external source and those which move by themselves. Life is reserved for the latter.

a) All subjects make errors and attribute life to some inanimate objects.
b) Discovery of autonomous movement does not definitely displace the inadequate or imperfect criteria of the first stage.
c) The child relies upon autonomy to justify some of his responses but for others still resorts frequently to usefulness, anthropomorphism, or general movement.
d) All subjects of this stage, however, at least make a mention of autonomous movement.

Stage 3 - Total Disappearance of Animistic Thinking

Stage 3 comprises all the subjects who never grant life to inanimate objects.

a) Life is reserved to animals and plants or to animals alone - some stage 3 children still refuse life to plants.
b) Explanations may refer to autonomous or general movement, to anthropomorphism, or to usefulness, indiscriminately.

Note: Disregard part #2 "Comparisons" in evaluating those protocols which would otherwise be Stage 3.

CRITERIA FOR THE EVALUATION OF THE ORIGIN OF NIGHT

Stage 0 - Incomprehension or Refusal

a) Refuse to answer the questions at all.
b) May give all kinds of associations elicited by the words of the examiner but do not really answer the questions.

Stage 1 - Absolute Artificialism

Stage 1 subjects usually begin by explaining the night in a finalistic manner. In most cases, however, the insistence of the questions will elicit a more explicit artificialistic explanation in the form of recourse to the action of God or to the intervention of terrestrial agents.

Substage 1A - Finalistic Interpretations - The subjects of substage 1A do not yet state their interpretations in a precise artificialistic form; they merely explain the night on the basis of its finality, or its usefulness to man.

Substage 1B - Finalistic and Artificialistic or Exclusively Artificialistic Interpretations - Either God or men are responsible for night, - most subjects also include some finalistic remarks.

Stage 2 - Semiartificialistic and Semiphysical Interpretations

In stage 2 artificialism assumes a more disguised form: the fabricating agent is still necessary, but henceforth, uses natural, physical elements (e.g. clouds, sun, etc.), or more rarely, artificial materials (e.g. the smoke from trains, etc.).

a) Stage 2 comprises all the children whose artificialism is interspersed with physical elements. These interpretations are almost always coupled with finalism, and sometimes even with animism.

Stage 3 - Absolute Physicalism

The third stage is characterized by the disappearance of artificialistic notions. Henceforth the darkness of night is explained by the action of strictly physical and natural elements, even if it doesn't always conform with reality.

Substage 3A - Physicalism Still Tainted With Finalism or Animism

a) The origin of night is natural but the explanation is saturated with finalistic beliefs relating night to sleep, and day to work.

b) The celestial bodies or the meteors responsible for the forming of the night, are sometimes explicitly considered to be alive.

Substage 3B - Physicalism Freed From Any Precausality

a) Some answers still remain ambiguous (e.g. "the sun goes down," "the sun hides behind the clouds," etc.) but, because they belong to adult colloquial vocabulary, it is not possible to regard them as sure evidence of animistic thinking.

CRITERIA FOR THE EVALUATION OF THE MOVEMENT OF CLOUDS

Stage 0 - Incomprehension or Refusal

a) Refusal to answer the question.
b) Refusal to acknowledge the movement of clouds.
c) Obvious lack of understanding of questions.
d) Some explanations belong to pure imagination and cannot be assimilated to real beliefs.
e) Inability to find personal solutions and consequently total acceptance of the examiner's suggestions.
f) In some cases, it's not the addition of inconsequential details, but rather the total absence of explanatory remarks that justifies Stage 0.
g) The explanatory system doesn't have to conform to reality but it must be consistent and expressly applied to the explanation of the phenomenon otherwise the protocol is classified Stage 0 and is thus considered equivalent to interps based upon pure imagination, fabulation or ignorance.

Stage 1 - Human or Divine Action

In Stage 1, the movement of clouds is explained by causes foreign to both meterology and physics. The artificialistic or magical techniques fully satisfy the children's intelligence. They do not themselves think of attributing a role, no matter how trifling, to phenomena contiguous in time or space such as celestial bodies, rain, wind, and the like. They never even mention these agents and it is only at the examiner's suggestion that some subjects will accept the role of the wind. But this concession is in no way a genuine conviction since, at the first opening, most subjects revert to their primitive system.

Stage 2 - Autonomous Movement or Action of Other Celestial Bodies

In the second stage, magical beliefs have completely disappeared. God's action is also much less frequent and above all much less exclusive. The child no longer considers that this action alone is sufficient to explain the movement of clouds: he always adds the necessary cooperation of an intermediary agent, chosen among celestial bodies, or among atmospheric phenomena, with the exception of the wind.

Stage 3 - Action of the Wind (Or Movement Regarded as Illusive)

The stage 3 child finds the correct explanation by himself: he spontaneously designates the wind as the cause of the movement of clouds and almost always holds to mechanical or physical principles.

Substage 3A - Correct Explanation But Still Tainted with Precausality

Child knows that the wind is involved but the physical cause is associated with residual forms of precausality.

Substage 3B - Correct Explanations Freed From Any Precausal Thinking

The movement of clouds is explained exclusively by the wind or as the result of an illusion, and no trace of primitive beliefs is observed. The child's notions on the origin of the wind are not always exact, but they no longer depend upon gross artificialism.

Note: The question "Can the clouds go where they want?" is often misinterpreted or understood to mean "Can the clouds go anywhere?" and may elicit pseudo-animistic answers.

CRITERIA FOR THE EVALUATION OF THE FLOATING AND SINKING OF OBJECTS

Stage 0 - Incomprehension

a) Predictions are usually made at random or do not seem to proceed from any valid principle.
b) Simple acquiescence in the examiner's most recent suggestion, systematic alternation or, most often, uniformity of prediction.
c) Child almost never justifies his predictions and has no greater success in explaining his empirical verifications.

Stage 1 - Precausal Explanations (Finalism, Animism, Dynamism)

In stage 1, the explanations do not go beyond the precausal level. Only finalistic, animistic, or purely dynamistic reasons account for the floating of bodies.

a) The last sections of the questionnaire yield no additional information.

Stage 2 - Physical Explanations, But Tainted With Illogical Reasons (Contradictions or Misconceptions)

The essential characteristic of children in this level is that the systems they elaborate utilize physical principles in either a wrong or contradictory way: the answers are either systematically false (e.g. everything heavy floats and everything light sinks), or else they simply contradict each other (e.g. some objects float because they are light, others sink, also because they are light).

Substage 2A - Illogical thinking is manifested as early as the first or second part of the questionnaire, that is, even before the proposal of the especially captious comparison between the large boat and the small marble. The child's explanations may be fully coherent, but they are systematically false in respect to reality or to the most elementary physical laws.

Substage 2B - Illogical answers do not hereafter appear until the third section of the questionnaire is reached. Up to that point, explanations are coherent and correspond to the facts. The comparison between the large boat and the small marble, however, confronts the child with a new and unexpected difficulty entailing the inconsistency specific to stage 2.

Stage 3 - Physical and Always Coherent Explanations

Predictions are almost always perfect and the rare errors arise mainly from a lack of information, or from misapplication of principles that in themselves are valid.

Substage 3A - Same solutions as in Substage 2B can be seen but there are somewhat more references to density, that is, to the presence of air or of a vacuum in the objects. The essential sign of accession to this stage is the cessation of contradictions or of illogical reasons.

Substage 3B - Reserved for the subjects who formulate the exact principle of the floating of bodies at least once during the examination.

APPENDIX C

SIGNIFICANT EXCERPTS FROM THE PROTOCOLS ILLUSTRATING EACH STAGE OF EACH QUESTIONNAIRE

The Concept of Dream

Stage 0: Incomprehension or Refusal

33(6)[1] - "Do you know what a dream is? - No.
Do you dream sometimes at night? - No."
(Further attempts at questioning were met with silence)

Stage 1: Integral Realism

66(6) - (After stating that dreams come from outside and are located somewhere outside in the room)

"If your mother was in your room could she see your dream? - Yes.
And if I were in your room, could I see your dream? - Yes.
Why do you say that I could see your dream? - Cause you were in my room."

Stage 2: Mitigated Realism

Substage 2A

128(6) - "Where are dreams made, where do they come from? - From God.
Do they come from inside you, or from outside you? - Inside.
Who makes the dreams come? Is it you or someone else? - God.
While you're dreaming, where is your dream? Where does it go on? - All over.
Is it inside you, or in your room? - Out here in the room.
While you are dreaming, are your eyes closed or open? - Closed.
Then where is the dream? - Outside.
Tell me, what do we dream with? - Our head.
What is a dream made of? Is it made of paper? - No.
Then what is it made of? - By God's stuff.
Can we touch our dream? - No - Why do you say that we can't touch them? - We can't feel them.
Is a dream a thought, or is it a thing? - A thing."

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[1] The first figure indicates the protocol number and the second figure, in parentheses, the child's age.

Substage 2B

143(6) - "Tell me, where does a dream come from? - Your mind.
Where are dreams made, where do they come from? - I don't know.
Do they come from inside you, or from outside you? - Inside.
Who makes the dreams come? - God.
If I were in your room, could I see your dream? - No.
Why do you say I couldn't see your dream? - You weren't in the room.
Then, tell me, what do we dream with? - Your brain.

Substage 2C

23(6) - "Where are dreams made? - I don't know.
Do they come from inside you, or from outside you? - They're like inside you. - Who makes the dreams come?
Is it you, or someone else, who? - It's me.
While you'r dreaming, where is your dream? Where does it go on? - I don't know. - Is it inside you or in your room? - It's going on outside in my room.
Is it in your room for real, or is it only as if it were there? - It's there alright!
What is a dream made of? Is it made of paper? Or what? - I would say paper. - Can we touch our dreams? - No. Why do you say we can't touch them? - Cause they're up in the air.
Is a dream a thought, or is it a thing? - A thing."

Stage 3: Integral Subjectivism

Substage 3A

65(6) - "Tell me, where does a dream come from? - Your head and your think.
Where are dreams made, where do they come from? - In your brain from God.
Do they come from inside you or from outside you? - Inside.
Who makes the dreams come? - The brain.
Why do we dream? Why are there dreams? - So you can see when your eyes are closed."

Substage 3B

53(8) - (After stating that the dream was in the mind and that no one else could see it)

"Then, why do we dream, why are there dreams? - It's just something that came up in your mind.

What is a dream made of? - Something that your mind makes up.
Can we touch our dreams? - No. - Why do you say that we can't touch them? - You can't touch something in your mind.
Is a dream a thought, or is it a thing? - A thought."

The Concept of Life

Stage 0: Incomprehension or Refusal

146(6) - "Is the sun alive? - No, it's not the moon.
Is an automobile alive? - No, it's not a truck.
Is a watch alive? - No, it's not a clock.
Is an airplane alive? - No, it's not a helicopter."

(The whole protocol was a series of responses which indicated that he really didn't comprehend)

Stage 1: Animistic Thinking Based Upon Usefulness, Anthropomorphism, or Movement

21(8) - "Is the sun alive? - I think so. If it was dead there wouldn't be any light.
Is an automobile alive? - I think so. It can move.
Is a cloud alive? - I think so. It can move.
Is the wind alive? - I think so. It can blow.
Is the fire alive? - Yes. It can burn things and make you warm.

Stage 2: Autonomous Movement With Some Residual Animistic Thinking

81(11) - "Is a cloud alive? - I don't think so. It doesn't eat or have a heart, It does have feelings though.
Is an airplane alive? - No. It needs something to help it move.
Is a bicycle alive? - No. It needs something to help it move.

Stage 3: Total Disappearance of Animistic Thinking

52(8) - "Is a mountain alive? - No. It can't talk or anything.
Is the sun alive? - No. It can't talk either.
Is a table alive? - No. You eat on it. I'd hate to be eaten on!
Is an automobile alive? - No. You ride in it.
Is a cat alive? - Yes. It's an animal.
Is a bird alive? - Yes. It gets babies and it can peep.

The Origin of Night

Stage 0: Incomprehension or Refusal

55(8) - "Do you know what the night is? Tell me, what is night? - When it's dark.
Why is it dark at night? - I don't know.
Where does the dark come from at night? - I don't know."
(Further questioning was met with silence)

Stage 1: Absolute Artificialism

Substage 1A: Finalistic Interpretations

25(6) - "Do you know what the night is? Tell me, what is night? - Dark.
Why is it dark at night? - So people can go to sleep.
Where does the dark come from at night? - I don't know.
Can we sleep during the day? Yes. - Then why is it dark at night? - Cause it's dark at night and sunny at day.
Why is it dark only at night? - That's when people go to sleep."

Substage 1B: Finalistic and Artificialistic or Exclusively Artificialistic Interp.

129(6) - "Tell me, what is night? - When it's dark out.
Why is it dark at night? - If it wasn't it wouldn't be night.
Where does the dark come from at night? - God.
How does God go about making the night? - He does it Hisself.
When it is light, why is it light? - God makes it light.
What makes it day? - God. He does everything."

Stage 2: Semiartificialistic and Semiphysical Interpretations

17(8) - "Where does the dark come from at night? - From the east. The clouds make it dark.
Where do these clouds come from? What makes these clouds? - From snow when it melts, it goes up in the air.
Why do these clouds come only at night? - They come in the daytime, too.
The clouds, at night, are they white or black? - Black.
Can white clouds make it night? - No. In the day they're white but a night they're black.

During the day, are there clouds sometimes? - Yes.
Then why, when there are clouds in the daytime, is it not dark like at night? - The sun comes out.
At night, is it black clouds that take the place of white ones, or white clouds which turn black? - The white clouds turn black."

Stage 3: Absolute Physicalism

Substage 3A: Physicalism Still Tainted with Finalism or Animism

14(8) - "Do you know what the night is? Tell me, what is night? - When the sun goes away and people have to go to sleep.
Why is it dark at night? - Because the way the earth turns around and stops at the other side.
Where does the dark come from at night? - That's a hard question. From the sky.

Substage 3B: Physicalism Freed from Any Precausality

46(11) - "Tell me, what is night? - When the sun goes in.
Why is it dark at night? - The sun isn't shining.
Where does the dark come from at night? - When the earth turns, it's sunny on one side and dark on the other.
When it is light, why is it light? - The sun.
What makes it day? - The turning of the earth.

The Movement of Clouds

Stage 0: Incomprehension or Refusal

15(8) - "Have you ever seen clouds moving forward? - No.
What makes them move? - They're not moving. You just see different ones like the same."

Stage 1: Human or Divine Action

111(8) - "Have you ever seen clouds moving forward? - Yes.
What makes them move? - God.
How does God go about making the clouds move? - He blows and blows and blows.
Can the clouds go where they want? - No. - Why can't they go where they want? - God doesn't want them to.
But why do the clouds move? - God wants them sometimes to rain so the flowers will grow.
Buy why do the clouds move fast sometimes, and sometimes move slow? - God blows real fast or real slow when He has time."

Stage 2: Autonomous Movement or Action of Other Celestial Bodies

34(6) - "Have you ever seen the clouds moving forward? - Yes, sometimes a little bit.
What makes them move? - Maybe the sky.
How does the sky go about making the clouds move? - Maybe it's the sky that's moving and the clouds move with it. Or when the clouds move they push the sky and the clouds come with it.
Do the clouds move by themselves alone, or is there something to make them move? - Maybe something inside pushes them along."

Substage 3A: Correct Explanation but Still Tainted with Pre-causality

13(8) - (After contending that the wind moves the clouds)

"Can the clouds go where they want? - Yes. - Why do you say they can go where they want? - Cause they move all around about the earth and they move around to give rain.
Do the clouds know they are moving? - Yes. - Do they know it's the wind that makes them move? - I don't know. And does the wind know that it makes the clouds move? - Yes."

Substage 3B: Correct Explanations Freed From Any Precausal Thinking

35(11) - (The movement seen as an illusion)

"Have you ever seen the clouds moving forward? - Yes. What makes them move? - We turn real slow. Instead of the clouds moving, we move. When the earth turns the clouds stay in one place. The clouds don't really move."

3(11) - "Have you ever seen clouds moving forward? - Yes. What makes them move? - The wind.
Why do the clouds move fast sometimes, and sometimes move slowly? - Cause the wind is faster sometimes.
Can the clouds go where they want? - No. - Why do you say they can't go where they want? - They don't really have a mind."

The Floating and Sinking of Objects

Stage 0: Incomprehension or Refusal

There were no Stage 0 subjects in this sample.

Stage 1: Precausal Explanations (Finalism, Animism, Dynamism)

32(6) - (After each prediction the child stated either "something's holding it up" or "nothing's holding it up")

"Tell me, why does a big boat stay on the water? - A big strong thing is holding it up.
Which is heavier: a big boat or a marble like this? - A big boat.
Does the marble go to the bottom? - Yes. - And does a big boat stay on top? - Yes. - Then why does a big boat stay on top of the water and a marble go to the bottom? - Something real strong holds the big boat up."

Stage 2: Physical Explanations, but Tainted With Illogical Reasons

Substage 2A

130(6) - "If I put this little boat on the water, will it stay on the water or will it sink, go to the bottom? - It will float.
Why do you think it will float? - Water makes the boat float.
Showing the big marble: will it go to the bottom or will it stay on top? - Sink. It's heavy.
Showing the wooden bead: will the bead stay on the water or go to the bottom? - Sink. It's light."

Substage 2B

131(6) - (After getting all of the predictions correct)

"Have you ever seen a big boat? Tell me, why does a big boat stay on top of the water? - I don't know.
Which is heavier, a big boat or a marble like this? - The marble.
Does the marble go to the bottom? - Yes. - And does the big boat stay on top of the water? - Yes. Then why does the big boat stay on top of the water and the marble go to the bottom? - Because the marble's heavier.
Which is heavier if you take them in your hands, the big boat or the marble? - The boat. - Then why does the boat stay on the water? - The water is high."

Stage 3: Physical and Always Coherent Explanations

Substage 3A

44(11) - (After getting all of the predictions correct and mentioning the presence of air in the wooden objects)

"Have you ever seen a big boat? Why does a big boat float? - It has enough mass under water to keep it stable.
Why does the big boat stay on top of the water and the marble go to the bottom? - The water weighs more in comparison to its size than the big boat.
Which is heavier if you take them in your hands, the big boat or the marble? - The big boat. - Then why does the big boat stay on top of the water? - It has enough under water to keep it stable yet it's lighter than the water."

Substage 3B

There were no Stage 3B subjects in this sample.

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